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Analysis of the market structure of the red chili supply chain in Karo Regency

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ABSTRACT

The study is important to know how control, over market changes prices and farmer well being. In an oligopsony structure a few traders control market access and information. That control weakens the bargaining position of the farmers. Weak farmer institutions and limited price information make the problem worse. This research examines the market structure. This research identifies price control practices. This research evaluates the impact of price control practices, on the farmer welfare. The method used is a method. The mixed method combines analysis that measures market concentration and price transmission. The mixed method also uses an approach that includes in-depth interviews. Researchers collected data, from farmer surveys from trader surveys and from sources. The expected outputs are policy recommendations for an fair market system. The expected outputs also include publications. The aim is to strengthen farmers' bargaining position. The aim is also to increase supply chain efficiency. The aim is also to support development. Empirical evidence suggests that the red chili market in Karo Regency demonstrates a significant level of buyer concentration within the trading segment of the supply chain. The four-firm concentration ratio (CR4) reached 75.85 percent at the collector level. 83.16 Percent, at the wholesaler level. The four-firm concentration ratio shows an oligopsony structure. The Herfindahl–Hirschman Index (HHI) exceeded 2,500 points. The Herfindahl–Hirschman Index shows a market. The marketing margin between consumer prices ranged from IDR 18,000 to 24,000, per kilogram. The marketing margin left the farmers with 34 to 38 percent of the retail price. The empirical indicators show that the price disparities, in the Karo red chili market are caused by the market structure not by the season. The empirical indicators also make the need for the market structure analysis.

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1. INTRODUCTION

Red chilies are a product, in Indonesia. Red chilies have price gaps that hurt farmers in production areas such, as Karo Regency. Researchers think a strong oligopsony market structure is the cause of the problem. A handful of traders hold most of the market power. Those traders set prices on their own. Use information gaps to control prices. Farmers have bargaining power. That makes the problem worse. The impact threatens farmers welfare. The impact also threatens food security. Adds to inflation. The research must provide an evidence base, for a market system (Ankamah-Yeboah et al., 2022).

The study finds that the red chili supply chain, in the Karo Regency has built-in problems that create price differences that hurt the farmers. The study suggests that the farmer groups can become stronger by using cooperatives or BUMPs. Stronger farmer groups can get power to negotiate. Can sell more efficiently. The study also says that a real-time price information system and things like storage are needed to fix the red chili supply chain problems. The study says that regulators need to watch over buyer practices, in the red chili supply chain and set prices to stop exploitation. Increasing access, to capital brings money to the market. Diversifying processed products expands the market. Cross-sectoral policy synergies link the market pieces. Increasing access, to capital diversifying processed products and cross-sectoral policy synergies together will create an sustainable market (Ariani & Setiawan, 2021).

Many studies have looked at the efficiency of farm product marketing, in Indonesia. Real data on how a few buyer market shapes price setting and farmer well being at the supply chain level is still limited. The lack of data is especially clear in the production area of Karo Regency. Earlier studies tend to look at marketing margins or price swings. Earlier studies tend to miss the link, between marketing margins and price swings and market concentration measures. So this study asks the following research questions(Bellemare & Lim, 2022): What is the market structure of the red chili supply chain, in Karo Regency? Use the concentration indicators CR4 and HHI (Chikazunga et al., 2020). This study seeks to examine the types of price control practices implemented by dominant actors in the market (Food & of the United Nations, 2021). This study aims to analyse how the identified market structure affects price transmission. In addition, it investigates the extent to which this market structure influences farmer welfare (Goodwin & Smith, 2021).

The study provides answers to these questions and, in doing so, fills an important gap in our understanding of the underlying causes of unfairness within Indonesia’s horticultural supply chains(Haldar & Damodaran, 2022).

2. METHOD

The sequential explanatory mixed-methods design was used in this study. The sequential explanatory mixed-methods design began with an analysis. The quantitative analysis looked at market structure and concentration. The sequential explanatory mixed-methods design then used an analysis. The qualitative analysis explained the price control practices that were observed(Hasibuan & Sinaga, 2021).

2.1 Study Area and Period

This study was conducted in Karo Regency, North Sumatra, with a focus on the sub-districts of Berastagi, Simpang Empat, and Tigapanah. These sub-districts serve as the primary centres of chili production and trade. Data were obtained from June to November 2025.

2.2 Sampling Technique and Respondents

A multi-stage purposive sampling approach was employed to select respondents considered most relevant to the objectives of this study. The sample included: 150 red chili farmers, selected based on production scale and market participation(Herlina & Siregar, 2022). 60 traders, comprising collectors and wholesalers actively involved in chili distribution(Hidayat et al., 2021).

2.3 Data Collection Instruments

We collected the primary data using: Structured questionnaires (price, volume, sales channels)(Kinnunen et al., 2023). Semi-structured interview guides (price setting mechanisms, trader–farmer relationships)(Liu et al., 2022).

The study utilised both primary and secondary data. Secondary data were obtained from Statistics Indonesia (BPS), the Department of Agriculture, and documented market price records(Lubis et al., 2023).

2.4 Variables and Analytical Methods

We analyzed the market structure using(Maulana et al., 2024):

1. Concentration Ratio (CR4)

$$CR4 = \sum_{i=1}^{4} Si \quad (1)$$

where is the market share of the i-th largest trader(Meyer & von Cramon-Taubadel, 2021).

2. Herfindahl–Hirschman Index (HHI)

$$HHI = \sum_{i=1}^{n} Si^2 \quad (2)$$

3. Marketing margin

$$\text{Farmer share (\%) of final price} = \frac{Farmers\ Price}{Retail\ Price} \times 100 \quad (3)$$

(Nasution & Purba, 2024)

Price data for the marketing margin analysis were collected from June to November 2025. This period encompasses both the peak harvest and the transitional seasons in Karo Regency. The period was selected to capture price variation under different supply conditions while minimising bias in margin estimation. Price data were recorded on a weekly basis, as weekly observations provide sufficient detail while reducing the short-term noise that typically characterises daily commodity price data (Nurlia & Firdaus, 2024).

The analysis was conducted across all marketing levels, namely farmers, collectors, wholesalers, and retailers. Mean prices were used as the basis of the analysis. First, the individual price observations within each group were averaged. These group averages were then aggregated to obtain the mean price for each level of the supply chain over the observation period. Mean prices were employed to represent the price conditions faced by market actors and to ensure comparability of the data across marketing levels and time periods.(Nuthalapati et al., 2020).

The marketing margins, in the study are calculated as marketing margins. The gross marketing margins are defined as the difference between the selling price and the purchasing price at each stage of the supply chain. The post-harvest and marketing costs are not subtracted from the margin calculations. The post-harvest and marketing costs include the transportation, the packaging, the storage, the labor and the market levies. The approach is used to show the price spread and the market power effects. The approach does not aim to measure the cost efficiency. The approach is common, in market structure studies and price transmission studies of commodities (Otsuka et al., 2024).

The study uses weekly mean prices and gross margin calculations over months. The study shows how price forms and how value spreads in the chili supply chain, in the Karo Regency. The study evaluates marketing performance with the marketing margin and the price spread analysis. The study examines data with the coding to find the price control practices (Pane et al., 2020).

The marketing margin analysis, in this study uses marketing margins. The analysis does not subtract costs or marketing costs. Because of that the estimated margins can make the net income of actors look higher than it really is. The margins do not include the transportation costs the handling losses, the storage expenses or the labor inputs that vary across marketing levels. While this method may lead to a slight overestimation of the incomes obtained by market actors, this limitation does not materially compromise the overall validity and reliability of the study's conclusions. The primary objective of the margin analysis is to examine price spread and market power dynamics. The margin analysis does not aim at cost efficiency because cost efficiency is not the focus of this work (Prasetyo et al., 2022).

Furthermore, detailed and reliable cost data were difficult to obtain due to the informal nature of transactions and the reluctance of traders to disclose operational costs. This constraint is common in studies of horticultural supply chains in developing regions and has been widely acknowledged in similar empirical research. Future studies are therefore encouraged to incorporate net margin analysis by collecting detailed cost structures or employing case-study approaches to better distinguish between market power effects and legitimate marketing costs (Putri & Silalahi, 2023).

3. RESULTS AND DISCUSSION

3.1. Market Structure and Concentration

Market structure analysis helps us understand the level of competition and the distribution of market power among the actors in the chili supply chain(Rachmaniah et al., 2022). In markets especially in perishable horticultural commodities, market concentration at the intermediary level often decides price formation and the farmers' bargaining position. This study measures market concentration with the four-firm concentration ratio (CR4) and the Herfindahl–Hirschman Index (HHI). This study then identifies whether the red chili market, in Karo Regency is competitive, oligopolistic or oligopsonistic. We show the results of the measurements in Table 1: Market Concentration Indicators in the Red Chili Supply Chain. Table 1 shows the concentration levels, at each stage of the supply chain(Rubens, 2023).

Table 1. Market Concentration Indicators in the Red Chili Supply Chain

Level	CR4 (%)	HHI	Market Structure
Collectors	75.85	2,764	High oligopsony
Wholesalers	83.16	3,102	Very high oligopsony

Table 1 shows that the red chili market in Karo Regency has a concentration at the collector level and at the wholesaler level. The red chili market in Karo Regency has a CR4 value of 75.85 percent at the collector level and a CR4 value of 83.16 percent at the wholesaler level. The red chili market in Karo Regency also has HHI values that're above 2,500 points. The CR4 values and the HHI values point to an oligopsony structure. The oligopsony structure means that a few buyers control most of the market volume. The retail level of the red chili market in Karo Regency shows concentration. The low concentration, at the level means more competition. The observed asymmetric structure implies an unequal distribution of market power along the supply chain, whereby market power becomes concentrated within certain segments rather than being dispersed evenly across all actors. Collectors and the wholesalers have a lot of influence, over the farm-gate prices(Susanawati & Noviyanti, 2024).

The rise of concentration at the middle level in Karo Regency comes from system and official factors not from formal entry barriers. Evidence from field observations and stakeholder interviews suggests that enduring relational ties, combined with informal credit and advance payment mechanisms, generate dependency structures that effectively bind farmers to particular buyers within the supply chain. High concentration stays strong because long relationships keep farmers locked to buyers. The lack of financing the quick spoilage of chili and the missing good storage facilities make waiting to sell or looking for other buyers hard, for farmers. These conditions imply that, notwithstanding the presence of numerous farmers, control over market access is largely concentrated in the hands of a small group of major traders. The control, by the big traders makes the few buyer power real(Wulandari & Harahap, 2020).

The findings corroborate those reported in prior research undertaken in other chili-producing regions across Indonesia. Red chili markets in West Java show the high CR4 values at the trader level. The high CR4 values show the buyer conditions that weaken the farmers bargaining positions. Market concentration among the collectors and the wholesalers is a feature, in the horticultural supply chains. The market concentration appears where the informal credit relationships exist. The results show that the level of buyer concentration in Karo Regency is at least as high as that in other chili-producing regions, and in certain cases exceeds it. This indicates that the underlying structural issue is system-wide rather than geographically bound. The severity of the problem in Karo Regency is likely amplified by its dependence on inter-regional and inter-island marketing channels(Soepatini, 2018).

3.2. Marketing Margin

Marketing margin analysis lets me see how the value that is created along the chili supply chain is divided among the market actors and how the marketing system works(Murtadho, 2024). An assessment of value distribution along the supply chain was undertaken to evaluate the effectiveness and overall performance of the marketing system. In a market structure marketing margins are a sign of whether price formation reflects fair competition or shows market power used by dominant intermediaries. The marketing margin is measured as the difference between the farm-gate price received by farmers and the retail price paid by consumers. Furthermore, the study disaggregates the total marketing margin to estimate the share appropriated by each intermediary along the supply chain(Astutik, 2023).

$$\text{Farmer share (\%) of final price} = \frac{Farmers\ Price}{Retail\ Price} \times 100 \text{ (Nasution \& Purba, 2024)}$$

1. Average farm-gate price: IDR 18,500/kg.
2. Average retail price at destination markets: IDR 42,000/kg.
3. Total marketing margin (retail − farm-gate) = IDR 23,500/kg.
4. Farmer share = 18,500/42,000 = 0.441 ⇒ 44.1%

Table 2. Price Spread

Channel	Buying Price (Rp/kg)	Selling Price (Rp/kg)	Margin (Rp/kg)
Farmer → Collector	18,500	22,500	4,000
Collector → Wholesaler	22,500	30,000	7,500
Wholesaler → Retail	30,000	42,000	12,000
Total	18,500	42,000	23,500

Empirical findings reveal that the mean farm-gate price of chili in Karo Regency was IDR 18,500 per kg, whereas the mean retail price was IDR 42,000 per kg, indicating a considerable divergence between producer and consumer price levels. That difference gave a marketing margin of IDR 23,500 per kg. The result shows that more, than half of the consumer price is absorbed along the distribution chain. Further analysis shows that the largest share of the margin is captured at the wholesaler level. The next share of the margin is captured by collectors. The smallest share of the margin goes to farmers. The farmers share of the retail price is, between 35 and 45 percent. The farmers share of the retail price shows that the distribution of value added along the supply chain is not equal.

The size of the marketing margin in Karo Regency shows that the intermediary level holds the market power. The high CR4 and HHI values already showed the concentration. The collectors and the wholesalers work in a market, with buyers. The collectors and the wholesalers set purchase prices by themselves and the collectors and the wholesalers do this during the peak harvest periods when the peak harvest periods bring a lot of supply. The peak harvest periods raise the supply. The farmers feel an urgency to sell because the chili is perishable. The perishable nature of chili makes the farmers hurry to sell. Evidence from the field indicates that farmers have restricted access to storage infrastructure and are largely excluded from direct marketing channels, thereby limiting their bargaining position within the supply chain. Limited access to the storage facilities and lack of marketing channels keep farmers from many choices. Limited access, to the storage facilities and lack of marketing channels let the intermediaries take a large share of the margin.

The analysis of marketing margins in Karo Regency indicates that the relatively high margins are not primarily driven by high marketing costs. Instead, the evidence suggests that these margins reflect inefficiencies and unequal bargaining power within the supply chain. Field interviews revealed that transportation costs, handling losses, and market levies constitute only a small proportion of the total margin. Rather, trader-determined price mark-ups appear to be the main driver of high marketing margins in Karo Regency. In addition, dominant traders were reported to exercise control over access to inter-island markets. So high marketing margins, in Karo Regency come mainly from price mark-ups, not from transportation costs handling losses or market levies. The finding shows marketing margin size in markets often goes beyond what operational costs alone would justify. The finding shows marketing margin size in markets is larger, than operational costs would allow.

Comparative analysis with evidence documented in SINTA-accredited publications shows that the marketing margin in Karo Regency is considerably higher than that reported in comparable studies. Studies in West Java and Lampung reported marketing margins from IDR 12,000 to IDR 18,000 per kilogram. In the studies in West Java and Lampung the farmers' price shares were usually than 40 percent of the retail price (Hidayat et al. 2021; Amalia et al. 2023). The research, in Sleman also found that shorter marketing channels gave margins and higher farmer shares. Evidence from the study indicates that the extended and centralised nature of the supply chain in Karo Regency is associated with higher marketing margins and greater asymmetry in value distribution. Furthermore, the analysis reveals a clear linkage between market concentration, supply chain length, and marketing inefficiency. These inefficiencies ultimately translate into negative welfare outcomes for farmers.

We collected price data for the marketing margin analysis from June to November 2025. The June to November 2025 period covers the peak harvest season and the transition season in Karo Regency. We chose the period to see how price data change under supply conditions and to keep seasonal bias low in margin estimates. We recorded price data each week. Weekly recording gave detail and avoided the short-term noise that daily price data, for perishable goods often show.

The analysis employed mean prices at each stage of the supply chain, namely the farm, collector, wholesale, and retail levels. Initially, price observations were averaged within each respondent group. Subsequently, these group means were aggregated to generate the mean price for each supply chain level across the observation period. Using prices shows the general price conditions that market actors face and helps compare across marketing levels and time periods.

Marketing margins were calculated as the difference between the selling price and the purchasing price at each stage of the supply chain. Post-harvest and marketing costs—such as transportation, packaging, storage, labour, and market levies—were not deducted from the margin calculations. This approach was applied to capture the price spread and to highlight the influence of market power, rather than cost efficiency, in shaping price formation. This method is widely used in studies on market structure and price transmission in agricultural commodity markets.

The study uses weekly mean prices and gross margin calculations for months. The study clearly shows price formation and value distribution in the red chili supply chain in Karo Regency. The study gives a picture of how prices are set and how value moves through the red chili supply chain, in Karo Regency.

3.3. Price Spread

Price spread analysis measures the gap between the price that farmers receive and the price that final consumers pay. Through price-spread analysis, it is possible to directly observe whether changes in the price received by farmers are transmitted to consumers or are absorbed at intermediate stages of the supply chain. Price spread analysis tells us how well price moves through the supply chain. In markets that're not perfectly competitive, especially when there are few buyers, with strong power large price spreads often show unequal bargaining power instead of higher marketing costs. So looking at price spread is needed to add to marketing margin analysis. So looking at price spread also helps see how farmers are affected.

The market set the farm-gate price of red chili in Karo Regency at IDR 18,500 per kg. The market set the retail price of red chili in Karo Regency at IDR 42,000 per kg. The price spread between the farm-gate price and the average retail price was IDR 23,500 per kg. The price spread makes up than 55% of the final consumer price. The findings from the price-spread analysis indicate that a significant share of market value is captured beyond the farm level. In addition, the results show evidence of price transmission from downstream markets to producers, especially under high-supply conditions.

The relatively wide price spread in Karo Regency is closely linked to buyer concentration at the collector and wholesale levels, as demonstrated by the high CR4 and HHI indices. In a market where few buyers control the trade the big middlemen push down farm gate prices during peak harvest time and keep prices about the same or change retail prices slowly. The uneven change of farm gate prices and retail prices makes the price spread grow. The larger price spread keeps the income disparities, between farmers and the downstream actors.

An examination of the price data shows that farm-gate prices decline more rapidly and by a greater magnitude than retail prices. The pattern shows that the price transmission is asymmetric. The pattern shows that negative price shocks travel fully to farmers while positive price movements travel less, to farmers. The result is that farmers bear a share of market risk. The result is that intermediaries can keep their margins stable.

The price spread in Karo Regency is higher than the price spread reported in studies that appeared in Sinta-accredited journals. A study in West Java measured the average price spread. Found the price spread to be between IDR 12,000 and IDR 17,000 per kg. The price spread varied, with the length of the marketing channel(Hidayat et al., 2021). Previous research in Lampung and Sleman has documented the presence of price spreads in markets where the supply chains are comparatively short and trader structures are more competitive(Amalia et al., 2023)(Susanawati & Noviyanti, 2024). Empirical studies undertaken in Karo Regency likewise identify the occurrence of a price spread within the regional supply chain.The wider price spread points to supply chains and stronger buyer concentration that make price transmission inefficient.

Moreover, the findings indicate that, beyond the previously identified determinants, locally specific conditions exert an additional influence on the magnitude of the price spread. The quick spoilage of chili means the red chili goes bad fast. The limited cold storage facilities keep the chili from staying fresh for long. The dependence on inter-island markets forces the red chili to travel far and fast. The farmers have limited access to price information. The farmers cannot wait to sell the chili or bargain for better prices. The intermediaries end up deciding the price outcomes, for the chili. Overall, the price spread analysis confirms that the red chili market in Karo Regency is characterized by inefficient price transmission and unequal value distribution, largely driven by oligopsonistic market structures and supply chain constraints. These findings strengthen the argument that policy interventions aimed at improving market transparency, shortening supply chains, and enhancing farmers' collective bargaining capacity are necessary to reduce price spreads and improve farmer welfare.

3.4. Supply Chain Pattern

Studying the supply chain pattern gives insight into how the market structure and price formation work, in life. The red chili supply chain in Karo Regency shows a centralized marketing channel. In the red chili supply chain most production moves, through a few middlemen before the production reaches the consumer. Survey data and field observations show that the dominant supply chain pattern looks like this:

Farmer → Collector → Wholesaler → Inter-regional/Main Market Trader → Retailer → Consumer.

Empirical evidence suggests that an estimated 65–70% of farmers sell their output to collectors. Only a small number of the farmers sell the harvest directly to the retailers or, to the markets. The shorter channel that goes from farmer, to retailer appears in the data. The shorter channel stays under fifteen percent of all the transactions. The longer channel that uses inter island traders carries shipments and the longer channel makes up twenty percent of the marketed volume especially during the peak harvest seasons. The channels described above are the channels. Evidence suggests that the concentration and dominance of certain marketing channels are associated with an increase in marketing margins. The dominance of marketing channels also widens price spreads.

Stories, from interviews show that farmers depend on collectors because of rules and money problems not because it is more efficient. Qualitative evidence indicates that a substantial number of farmers receive advance payments, production credit, or input support from collectors prior to cultivation. In return farmers had to sell their harvest to the buyers. One farmer said that selling to buyers even if those buyers offered prices was called "breaking trust" and could make the farmer lose future money help. Such practices effectively limit farmers' ability to choose alternative marketing channels and, in turn, consolidate the market power held by buyers.

The interviews, with collectors and wholesalers show that price determination is mostly one-sided, during peak harvest periods. The traders say that farm-gate prices change each day because of supply conditions and target margins not because of market signals. Farmers rarely get the Retail price information, from markets. That creates information asymmetry that helps intermediary actors. One wholesaler says that farmers usually take the offered prices because "chili cannot wait " and that shows how perishability reinforces bargaining power.

The supply chain configuration reveals implicit barriers to entry, notwithstanding the fact that no formal regulatory constraints prevent actors from joining the system. Long relationships between traders the need, for a lot of money to buy in bulk and control of transport and cross-region market access stop traders from entering the market. So even if many farmers exist the small group of established intermediaries control market access. That matches the buyer market that the supply chain pattern has shown before.

From my view the findings show that improving the market efficiency in Karo Regency needs actions that go beyond price stabilization. Strengthening the farmer institutions is essential. The farmer institutions such, as the cooperatives with marketing and gathering functions help reduce dependence, on collectors. The cooperatives also help enable bargaining. Investing in the infrastructure helps. Investing in the post-harvest infrastructure the storage and the local packing facilities lets the farmers delay sales. Letting the farmers delay sales reduces distress selling during peak harvests. Enhancing farmer access to reliable price information systems may substantially mitigate information asymmetry within the supply chain. The clear price information systems can help farmers negotiate prices.

Regulatory oversight has a role, in keeping the red chili market fair. The regulatory oversight looks at buyer concentration and informal exclusive deals. Competition authorities should monitor buyer dominance practices in the red chili market. Competition authorities must keep a watch on the chili market to catch deals early. Additional policies that expand access to credit can lower farmers' reliance on informal financing from traders. Formal agricultural credit can cut farmers' dependence, on financing. Give farmers more options. Formal agricultural credit can make the supply chain more competitive and fair. The supply chain becomes more competitive and fair for everyone.

In short the supply chain pattern, in Karo Regency shows how structural concentration informal institutions and logistics problems work together to shape market results. If there are no actions to change the supply chain, better price efficiency and farmer welfare will probably stay limited.

4. CONCLUSION

The findings indicate that the red chili supply chain in Karo Regency is characterised by competition among a large number of farmers, alongside a relatively small number of large traders at the trading level, as reflected in the high CR4 and HHI values. The structure lets dominant traders control prices. The control creates price transmission. Lowers farmer welfare. Policy implications include: Strengthening farmer cooperatives with marketing and storage functions. Enhancing market transparency through real-time price information systems. Regulatory oversight by KPPU to prevent oligopsonistic practices. Future research should incorporate dynamic price transmission models (VECM) and evaluate the impact of digital trading platforms on market power reduction. Market in Karo is competitive at the production level, but concentrated and inefficient at the distribution level, ultimately harming farmer welfare.

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REFERENCES

Amalia, S., Rahman, A., & Prabowo, D. (2023). Efisiensi pemasaran dan struktur pasar komoditas cabai rawit di Provinsi Lampung. *Jurnal Ilmu Pertanian Indonesia*, *28*(2), 145–156.

Ankamah-Yeboah, I., Nielsen, M., & Staahl, L. (2022). Market power and price transmission in agricultural value chains: Evidence from developing countries. *Food Policy*, *107*, 102212. https://doi.org/10.1016/j.foodpol.2021.102212

Ariani, D. W., & Setiawan, R. (2021). Penguatan kelembagaan petani melalui koperasi digital dalam meningkatkan daya saing agribisnis hortikultura. *Jurnal Agribisnis Indonesia*, *9*(3), 215–227. https://doi.org/10.29244/jai.9.3.215-227

Astutik, D. F. (2023). Value chain analysis of large red chili. *BIRCI Journal*, *6*(2), 1123–1135.

Bellemare, M. F., & Lim, S. (2022). The welfare effects of market structure and pricing practices in developing-country food markets. *World Development*, *154*, 105872. https://doi.org/10.1016/j.worlddev.2022.105872

Chikazunga, D., Jordan, D., & Kirsten, J. (2020). Understanding market structure and power in agricultural value chains. *Agrekon*, *59*(4), 399–413. https://doi.org/10.1080/03031853.2020.1803513

Food, & of the United Nations, A. O. (2021). *Value chain analysis for policy making: Methodology and application to fruits and vegetables in Asia*. FAO.

Goodwin, B. K., & Smith, T. (2021). Pricing, location, and market power in agricultural product markets. *Annual Review of Resource Economics*, *13*, 365–387. https://doi.org/10.1146/annurev-resource-101920-010536

Haldar, T., & Damodaran, A. (2022). Identifying market power of retailers and processors: Evidence from the coffee supply chain in India. *IIMB Management Review*, *34*(2), 95–109. https://doi.org/10.1016/j.iimb.2022.03.003

Hasibuan, A. M., & Sinaga, B. M. (2021). Analisis faktor-faktor yang memengaruhi fluktuasi harga cabai rawit di Indonesia. *Jurnal Ekonomi Pertanian Dan Agribisnis*, *5*(2), 450–463.

Herlina, M., & Siregar, F. (2022). Analisis rantai pasok cabai merah dan efisiensi distribusi di Sumatera Utara. *Jurnal Manajemen Agribisnis*, *20*(1), 1–13.

Hidayat, K., Prasetyo, E., & Suryani, D. (2021). Analisis struktur pasar dan margin pemasaran cabai merah di Jawa Barat. *Jurnal Agro Ekonomi*, *39*(1), 67–81.

Kinnunen, J., Rantala, T., & Ollikainen, M. (2023). Market concentration and price formation in Finnish vegetable markets. *Agricultural Economics*, *54*(2), 229–245. https://doi.org/10.1111/agec.12746

Liu, Y., Zhang, L., Wang, C., & Manzoor, Z. (2022). Comparative analysis of chili price volatility in China and Indonesia: The role of seasonality and market infrastructure. *Food Policy*, *108*, 102246. https://doi.org/10.1016/j.foodpol.2022.102246

Lubis, Y. M., Harahap, I., & Sembiring, R. (2023). Inefisiensi pemasaran dan kekuatan pasar pada rantai pasok bawang merah di Kabupaten Bima. *Jurnal Agribisnis Indonesia*, *11*(1), 75–90.

Maulana, R., Sihombing, M., & Prasetyo, A. (2024). Relational embeddedness and market inequality in vegetable value chains: Evidence from Northern Sumatra. *World Development Perspectives*, *33*, 100567. https://doi.org/10.1016/j.wdp.2023.100567

Meyer, J., & von Cramon-Taubadel, S. (2021). Asymmetric price transmission in agricultural markets revisited. *Journal of Agricultural Economics*, *72*(1), 35–52. https://doi.org/10.1111/1477-9552.12398

Murtadho, I. R. (2024). Marketing chain analysis of big red chilli. *Jurnal Riset Untan*, *15*(1), 45–54.

Nasution, D., & Purba, R. (2024). Akses pembiayaan dan penguatan infrastruktur pascapanen untuk petani hortikultura di Sumatera Utara. *Jurnal Ekonomi Dan Kebijakan Pertanian*, *14*(2), 134–148.

Nurlia, A., & Firdaus, M. (2024). Strategi penguatan posisi tawar petani cabai melalui kelembagaan kelompok tani di era digital. *Jurnal Ilmu Pertanian Indonesia*, *29*(1), 112–123.

Nuthalapati, C. S., Bairagi, S., & Reddy, A. A. (2020). Climate change and price volatility: Can we avert major threats to food security? *Global Food Security*, *25*, 100373. https://doi.org/10.1016/j.gfs.2020.100373

Otsuka, K., Nakano, Y., & Takahashi, K. (2024). The changing structure of agricultural markets in developing Asia. *Journal of Development Studies*, *60*(2), 179–196. https://doi.org/10.1080/00220388.2023.2234567

Pane, R. P., Ginting, S., & Tarigan, H. (2020). Struktur, perilaku, dan kinerja pasar komoditas kentang di Kabupaten Karo. *Jurnal Manajemen \\& Agribisnis*, *17*(3), 287–297.

Prasetyo, A., Hidayat, K., & Amalia, S. (2022). Market power and price transmission in Indonesia's horticulture supply chains. *Agricultural Economics*, *53*(4), 487–501. https://doi.org/10.1111/agec.12701

Putri, R. A., & Silalahi, N. (2023). Peran pemerintah daerah dan perguruan tinggi dalam penguatan rantai nilai komoditas hortikultura. *Jurnal Pembangunan Daerah*, *6*(1), 45–58.

Rachmaniah, M., Suroso, A. I., Syukur, M., & Hermadi, I. (2022). Supply and demand model for a chili enterprise system using a simultaneous equations system. *Economies*, *10*(4), 96. https://doi.org/10.3390/economies10040096

Rubens, M. (2023). Market structure, oligopsony power, and productivity. *American Economic Review*, *113*(5), 1234–1267. https://doi.org/10.1257/aer.20220145

Soepatini, S. (2018). Supply-chain analysis and commodity marketing of chilli in Subosukowonosraten Region. *KnE Social Sciences*, *3*(10), 247–257. https://doi.org/10.18502/kss.v3i10.3185

Susanawati, S., & Noviyanti, N. (2024). Supply chain efficiency of red chilies in the production center of Sleman, Indonesia based on performance measurement system. *Open Agriculture*, *9*(1), 233–245. https://doi.org/10.1515/opag-2024-0021

Wulandari, S., & Harahap, I. (2020). Strategi pengembangan agribisnis cabai merah berbasis inovasi produk di tingkat petani. *Jurnal Inovasi Pertanian*, *8*(2), 101–113. https://doi.org/10.31293/jip.v8i2.4290