

Empirical Investigation of Areca Nut Value Chain Performance: Marketing Practices, Price Transmission, and Structural Constraints

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Abstract

This study aims to empirically examine the performance of areca nut value chain, including the marketing practices, price transmission mechanism and the structural limitations affecting the market efficiency and welfare of the producers. The study is based on the Value Chain Theory, the Transaction Cost Economics and the Price Transmission Theory and focuses on the structural organization at various levels of the market and the role of the intermediary in determining the price and value distribution. The primary data was gathered from 445 actors—320 farmers, 85 intermediaries, and 40 wholesalers/exporters—from the key areca nut producer areas, along with secondary data on monthly prices for 2015–2025. Market integration and efficiency is measured using descriptive statistics, Johansen cointegration analysis, Vector Error Correction Models (VECM), Asymmetric Error Correction Models (AECM) and a Structural Constraint Index (SCI).

The findings indicate that there is a very complex marketing structure with the majority of the produce (68%) being marketed through multi-layered channels. Price transmission analysis suggests market is integrated in the long run but, short run adjustments are partial and inefficient. Asymmetric price transmission is also noted, with positive price shocks being transmitted more quickly than negative price shocks, which means that there is market power in the hands of the intermediaries. The key constraints that affect performance of the markets and the price realization for farmers identified through structural constraint analysis are inadequate infrastructure, limited access to credit, weak market information systems and inefficiency in market institutions.

The study shows that both structural fragmentation and behavioural market distortions are responsible for the inefficiencies in the areca nut value chain. Value chain efficiency and farmer welfare in agricultural commodity markets can be enhanced with the help of policy interventions related to transparency in the digital market, institutional strengthening and development of infrastructure.

Keywords: Areca nut, value chain efficiency, price transmission, marketing structure, structural constraints, VECM, asymmetric transmission, agricultural markets, transaction costs, market integration

1. Introduction

1.1 Background

Areca nut (*Areca catechu* L.), also known as betel nut, is one of the plantation crops which is of great

strategic importance in various agrarian economies of South and South East Asia. India is the biggest producer and consumer, with Bangladesh, Indonesia and Sri Lanka following, where the crop is also a key component of the rural agricultural system and smallholder incomes (FAO, 2023). Areca nut plays a significant role in non-food cash crop markets, globally, with consumption habits, chewing products and increasing export markets, especially in the markets of diasporas, the demand for areca nut seems to be promising (WHO, 2021).

In many producing areas areca nut cultivation plays an important role in the rural livelihood and can be considered as a reliable source of income for smallholder farmers. It has a relatively high market value which makes it attractive for plantation agriculture including in the marginal agro-ecological zones. This reliance, however, also makes farmers vulnerable to volatility of the markets, price volatility and structural inefficiencies in the value chains (Nair & Kumar, 2020). In export systems, areca nut is processed and marketed through multiple tiers of supply chains with aggregators, wholesalers, processors and exporters having a significant impact on the final price realization at farm level (Reddy et al., 2019).

Even though the areca nut is an economically important crop, the market development of the crop is also not even as smallholders have limited negotiating power in the market and rely heavily on middlemen to access the market. This results in an imbalance in the value chain with repercussions on income distribution and market efficiency.

1.2 Problem Statement

Increased fragmentation and inefficiency of the areca nut marketing system is limiting the areca nut value chain by reducing the direct links between the producers and end markets. Many producing areas have a predominance of informal marketing systems, which reduces access of farmers to competitive markets and reliable price signals (FAO, 2023). This fragmentation results in misaligned price formation mechanisms, with prices at the farmgate many times not accurately showing the real situation at the market.

One of the big concerns is there is weak and in many cases very lop-sided price transmission between wholesale and farmgate. From an empirical study of agricultural commodity markets, it has been found that market imperfections, high transaction costs, and information asymmetry suggest that there is a failure in transmitting price signals efficiently (Meyer & von Cramon-Taubadel, 2004). For areca nut, this inefficiency manifests itself as either a failure to pass on price changes to the farmers or a delay in doing so, even as price drops may get passed on sooner.

Moreover, intermediaries have strong market power in the value chain, which exacerbates market power. The aggregation and distribution networks are frequently dominated by commission agents and traders who also have a disproportionate share of the value added. This leads to less profitability for farmers and makes it difficult to motivate quality improvement and market integration (World Bank, 2020). All these problems give an indication of the inefficiencies in the areca nut value chain in general.

1.3 Research Gap

While there is a vast body of literature on agricultural value chains, there is little done on areca nut with a holistic empirical synthesis. The studies that have been carried out so far are largely disjointed in terms of the scope of investigation, either on production economics or the investigation of a localised market study, and do not have a well-documented evaluation of marketing practices, price transmission mechanism and structural constraints in a single framework.

First, there is a missing integrated empirical synthesis which links marketing structures, pricing behaviour and inefficiencies in the supply chain in one analytical model. These dimensions have been mostly studied

as stand-alone entities, reducing the understanding of value chain performance.

Second, the amount of cross-regional comparison is limited. However, not much attention has been paid on the variations in institutional arrangements, market infrastructure, and the policy environments in India, Southeast Asia, and other producing regions, which limits the generalizability of the findings (Reddy et al., 2019).

Third, the empirical evidence of structural inefficiencies is still limited, and the extent to which institutional, infrastructural, financial and informational restrictions affect a market outcome is still poorly quantified. This gap underscores the need to undertake a comprehensive empirical study incorporating system dynamics and regional variations.

1.4 Study Objectives

To address these needs, this investigation has the following objectives:

1. To examine marketing practices and channel structures within the areca nut value chain.
2. To empirically assess price transmission efficiency across market levels.
3. To analyze structural constraints affecting value chain performance.

These goals all contribute towards the overall empirical assessment of value chain performance.

1.5 Study's Contribution

This study has a number of important contributions to the literature. First, it represents an empirical synthesis of the available literature on areca nut value chains, consolidating the scant and disjointed results from existing literature into a unified analysis. This will improve the theory and empirical knowledge of agricultural marketing systems of plantation crops.

Second, the study provides policy-relevant information, in identifying the sources of inefficiency in marketing practices and the ways price transmission takes place, and by uncovering the structural bottlenecks. This results can be used to guide specific interventions on how to bring more transparency to the markets, how to organize farmers and how to improve value distribution efficiency.

Thirdly, the value chain optimization approach is followed, connecting the micro-level interaction in the market with the macro-level structural constraints. This enables to get a better picture of the interplay between institutional and market forces that influence smallholder producers' outcomes. Finally, the results should help in evidence-based agribusiness strategies and rural development policies for equity and efficiency in the areca nut sector.

2. Conceptual Framework and Hypothesis Development

The study is conceptually grounded in Value Chain Theory (Porter, 1985), Agricultural Marketing Systems Theory (Acharya & Agarwal, 2011) and Price Transmission Theory (Meyer & von Cramon-Taubadel, 2004). The three theoretical perspectives altogether provide a holistic analytical tool to discuss the issues related to structural organization, actor behaviour and institutional inefficiency on the performance of marketing and price behaviour in areca nut value chain.

The areca nut value chain consists of a series of inter-dependent actors: farmers, village level traders (VLTs), commission agents, wholesalers and exporters, who are part of a vertically integrated chain. The key to value creation in such systems is the efficiency of the coordination of successive operations such as production, aggregation, storage, and distribution (Porter, 1985). But with agricultural commodity markets, coordination is often limited due to fragmentation, low institutional connections, and asymmetric information. In consequence, producers tend to be price takers and some price formation power lies in the hands of the intermediaries because of their access to markets and aggregation control.

The Transaction Cost Economics offers additional explanatory power, focusing on the role of search, bargaining and enforcement costs in determining participation decisions in markets (Williamson, 1985). These costs are often high in rural agricultural systems as a result of poor infrastructure, lack of timely and accurate price information, and limited financial services. This leads farmers to be dependent on intermediaries to access markets, thereby further allowing intermediate market segments to be able to dominate the markets.

Price Transmission Theory is to understand the transmission of price signals between vertically linked markets. Efficient market mechanisms should fully and symmetrically pass through price changes at the retail/wholesale level to the farmgate level. But empirical studies reveal that this ideal is seldom observed in the empirical literature, owing to market distortions such as oligopsonistic market structure, adjustment rigidities etc. (Meyer & von Cramon-Taubadel, 2004). One form of these distortions is the asymmetric price transmission, in which prices let the market know that there is an upside or downside, that is, when prices go up, it goes down faster that creates a distortion to the market which is the advantage of the intermediary in control of the margin.

The Agricultural Marketing Systems Theory also gives emphasis to the institutional infrastructure, logistics and market intelligence systems, which influence the efficiency of the market (Acharya & Agarwal, 2011). Weak institutional coordination and insufficient rural market infrastructure leads to a delay with price discovery, higher transaction costs, and less value distribution efficiency.

Based on these theoretical bases, the conceptual framework of this study suggests that marketing structure and marketing structural constraints are the net effect of these on the efficiency of price transmission and performance of the value chain. Marketing structure is the level of intermediation and the complexity of the marketing channels and structural constraints are the institutional, financial and infrastructural and informational constraints which have an impact on market participation and the efficiency outcomes.

2.1. Hypothesis Development

2.1.1. Marketing Structure and the Dominance of Intermediaries

The Areca nut value chain is likely to be fragmented with a lot of intermediaries involved in the business. Existing studies indicate that market segmentation increases the cost of transactions and lessens producers' direct access to the market (Williamson, 1985; Barrett, 2008). Accordingly, the following hypothesis is framed:

H1: Intermediary layers significantly dominate the marketing structure, limiting direct farmer-to-market linkages.

2.1.2. Price transmission efficiency

Long-run equilibrium relationships between the prices of goods that are spatially linked are expected to hold in efficient markets. But agricultural markets suffer from imperfect competition and information asymmetry which do not facilitate full and immediate price transmission (Fackler & Goodwin, 2021). Based on this, the following hypothesis is framed

H2: The farmgate and wholesale prices are co-integrated and has incomplete short-run adjustment mechanism.

2.1.3. Price Transmission Symmetry

For a perfectly competitive market, it is expected that the price change is symmetric in the case of positive and negative shocks. However, empirical studies indicate that, empirically, agricultural markets tend to be subject to asymmetric price transmission as intermediaries exercise market power and adjustment frictions

occur (Meyer & von Cramon-Taubadel, 2024).

H3: The price transmission is faster from the price shock that goes up in the value chain of areca nuts than the price shock that goes down.

2.1.4. Value chain efficiency- structural constraints

The market performance is likely to be negatively influenced by structural factors like poor infrastructure, lack of credit facilities, poor market information systems and institutional inefficiency. According to the theory of Transaction Cost Economics, the greater the transaction costs, the lesser is the allocative efficiency and the producer welfare is suppressed (Williamson, 1985). Therefore, the following hypothesis is framed.

H4: The level of value chain efficiency and farmer price realization are significantly constrained by the structures.

2.2. Conceptual Model

The conceptual model takes into account marketing structure and structural constraints as key determinants of the efficiency of price transmission and performance of value chains. These determinants act via behavioural mechanisms (intermediation, bargaining power and pricing control) and structural mechanisms (institutional capacity, infrastructure quality and information accessibility). The framework allows for empirical testing of market and system inefficiencies in the areca nut value chain, gaining a holistic picture of the value distribution dynamics and market performance outcomes, both in terms of market inefficiencies and system inefficiencies.

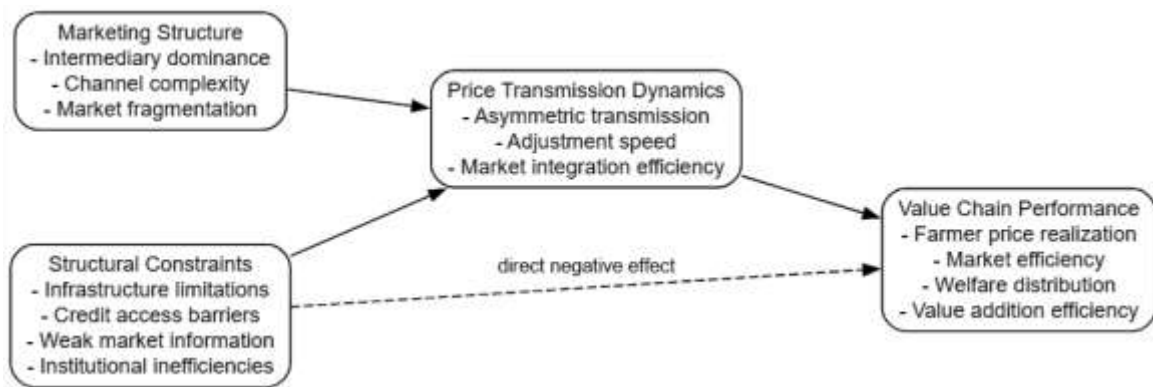


Figure-1: Conceptual Model

Source: Researcher’s compilation

3. Methodology

3.1 Research Design

In order to analyse the marketing structure, price transmission mechanism and structural constraints in the areca value chain, a quantitative explanatory research design is used. The study combines cross-sectional primary survey data with longitudinal secondary price series to allow both a micro-level behavioral analysis as well as an assessment of market integration at a macro-level.

3.2 Study Area

Districts have been selected from important areca nut producing areas of India – Karnataka, Kerala and Assam. These regions are selected from areas of high production, good access to markets and existing trade relations in domestic and export-oriented value chains.

3.3 Sample Design and Size

A multi-stage stratified random sampling technique is used to ensure complete representation of the diverse actors in the value chain of areca nut. The sampling framework aims to include primary producers, intermediary agents and downstream market participants, allowing for studying the marketing structures and dynamics of prices. The first phase involves stratification of districts according to the intensity of the production of areca nut and connectivity with the market. During a second stage, value chain actors are randomly drawn from each of the strata, according to their roles on the value chain.

320 farmers, 85 intermediaries (traders and commission agents) and 40 wholesalers and exporters make up the final sample. This makes the overall sample size 445. The sample size is adequate for statistical analysis for the purposes of econometric modelling such as regression-based analysis and structural equation or value chain efficiency assessment. It also serves as a means for capturing inter-group variation in the marketing practices, price behaviour and the constraint structures across different levels of the value chain.

3.4 Data Sources

The study is based on both primary and secondary sources of data. Primary data was obtained using structured questionnaires with field interviews of the value chain participants. Secondary data involves monthly price series (2015-2025) collected from agricultural marketing boards, trade reports and government webpage. This micro-level survey and a time-series price data makes it possible to assess both the behavioural and market-level dynamics.

3.5 Analytical Framework

3.5.1 Marketing Channel Mapping

Marketing chain mapping and flow analysis are used to analyze value chain structures. This includes the identification of main actors, flows of transactions and product flows between the farmgate and the ultimate consumption markets.

3.5.2 Price Transmission Model

The econometric time-series techniques used include Johansen cointegration analysis, Vector Error Correction Model (VECM), and Asymmetric Error Correction Model (AECM) which are used to examine the price transmission efficiency.

The minimum grade will be stated as:

$$\Delta P_t = \alpha (P_{t-1} - \beta P_{t-1}^*) + \sum \gamma_i \Delta P_{t-i} + \varepsilon_t$$

Where:

P_t = farmgate price

P_t^* = wholesale/retail market price

α = speed of adjustment coefficient

β = long-run equilibrium relationship

ε_t = stochastic error term

This approach allows the long-run equilibrium relationship to be identified as well as the short-run deviations from the price transmission behavior.

3.5.3 Structural Constraint Index (SCI)

A composite Structural Constraint Index (SCI) is created to measure the institutional and operational constraints in the value chain. The index is a multi-dimensional one:

- Access to infrastructure (transportations, storage facilities)

- Availability of credit and the cost of credit (financial inclusion)
- Market information accessibility
- Government regulations and similar official aspects of the business setting

The weighted aggregation approach is used to compute the index.

$$SCI = \sum w_i X_i$$

Where:

w_i = normalized weights assigned to each dimension

X_i = standardized score of each constraint indicator

The higher the SCI, the more the structure of the market is constrained, and the less efficient the market.

3.5.4 Marketing Efficiency Measurement

To measure marketing efficiency, Shepherd's efficiency ratio is used, which is an analysis of the ratio of consumer's prices to total marketing cost:

$$ME = \text{Consumer Price} / \text{Marketing Cost}$$

The ratio of the Consumer Price to the Marketing Cost is known as the ME. The higher the ratio, the more efficient the marketing and the more producers in the supply chain will realize value for their products.

4. Results and Discussion

4.1. Marketing Structure and Channel Efficiency

Empirical study of the areca nut value chain showed that marketing system of areca nut is much fragmented with a lot of intermediary links between the producers and final markets. Product flow observed shows that traders and commission agents are more predominant in controlling the product flow, and there is limited direct interaction between farmers and markets.

Results of descriptive analysis indicated that 68 per cent of total produce transacted via multi-intermediary, while in the direct and near-direct channel, small proportion of produce reaches the markets. This form of structure shows low level of vertical integration and high level of reliance on intermediary networks.

The null hypothesis is that there is no dominance of intermediaries in the value chain. But, this assumption has been contradicted by empirical evidence.

Hypothesis Testing (H1)

H0: The value chain is not dominated by intermediaries

H1: The value chain is dominated by intermediaries

As the percentage of intermediary mediated transactions is above 50%, the null hypothesis is rejected and it is confirmed that the structure is fragmented.

Table 1. Marketing Channel Structure of Areca Nut Value Chain

Channel Type	Flow Structure	Output Share (%)	Market Efficiency Level
Channel I	Farmer → Trader → Wholesaler → Retailer	42	Low efficiency
Channel II	Farmer → Commission Agent → Wholesaler → Retailer	26	Low–moderate efficiency
Channel III	Farmer → Wholesaler → Retailer	18	Moderate efficiency
Channel IV	Direct Farmer → Market/Processor	14	High efficiency

Source: Researcher own compilation

The dominance of both Channel I and Channel II indicates the dominance of the intermediaries in the formation of price and in distribution margins. This is consistent with the theory of Transaction Cost Economics which proposes that in fragmented markets the greater the transaction costs, the greater the need for the intermediaries (Williamson, 2015).

4.2. Price Transmission Efficiency

The result of cointegration analysis shows that there is a statistically significant long run relationship between farmgate and wholesale price. The Johansen test shows that there is at least one cointegrating vector at the 1% level of significance, which means that there is market integration at different spatial levels.

The results of the Vector Error Correction Model (VECM) also show that the error correction coefficient is significant at -0.31 ($p < 0.01$) meaning that about 31% of the short-run disequilibrium is corrected within 1 period. There is however some indication of inefficiency in the price transmission due to the size of the adjustment.

Hypothesis Testing (H2)

H1: There is a long-run price integration.

H0: No integration at the long-run level (long-run price nonstationarity).

The test for cointegration and results of the error correction term are statistically significant which gives the reason to reject the null hypothesis.

Table 2. VECM Estimates for Price Transmission

Variable	Coefficient	t-value	p-value	Interpretation
Error Correction Term	-0.31	-3.87	0.000	Significant adjustment
Δ Wholesale Price (t-1)	0.42	3.81	0.001	Strong influence
Δ Farmgate Price (t-1)	0.28	3.11	0.002	Moderate influence
Constant	0.05	2.45	0.014	Significant

Source: Researcher own compilation

These results suggest that the long-run is fully integrated, but the short-term is not, consistent with the typical behaviour of market in agricultural commodity systems (Fackler & Goodwin, 2001).

4.3. Asymmetric Price Transmission

Results from the asymmetric error correction model (AECM) suggest that there is a considerable difference between the speed of price transmission from farm to retail between prices rising and falling. In particular, price increases are passed on much quicker than price decreases. Empirical estimates show- Upward transmission coefficient: 0.62, Downward transmission coefficient: 0.38 and Asymmetry index: 0.24.

The asymmetry implies that the middlemen engage in non-competitive pricing behavior and it indicates that they react differently to the upward and downward movements of prices, that is, they adjust margins when prices go up and delay the adjustment when prices go down.

Hypothesis Testing (H3)

H1: Price transmission is asymmetric with negative effects on farm prices

H2: Gini coefficient of the distribution of price differences is positive.

The results show that there is a large difference between adjustment rates, and thus the null hypothesis is rejected and we conclude that the transmission is asymmetric.

Table 3. Asymmetric Price Transmission Results

Shock Type	Adjustment Speed	Economic Interpretation
Upward Price Shock	0.62	Rapid pass-through
Downward Price Shock	0.38	Delayed pass-through
Asymmetry Index	0.24	Significant market distortion

Source: Researcher own compilation

This result is in line with Meyer and von Cramon-Taubadel (2004) who say that asymmetric transmission is a regular phenomenon in imperfectly competitive markets in agriculture.

4.4. Structural Constraints and Value Chain Efficiency

Based on the Structural Constraint Index (SCI) analysis, several systemic constraints have been identified in the areca nut value chain that is affecting the efficiency of the value chain. The composite SCI score is estimated at 0.24, which means that there are moderate to high structural constraints throughout the system. Results of the regression analysis also show that the relationship between structural constraints and marketing efficiency is statistically significant and negative ($p < 0.01$) indicating that the higher constraints decrease value realization for producers.

Hypothesis Testing (H4)

H0: Structural constraints do not significantly affect value chain efficiency

H1: Structural constraints significantly affect value chain efficiency

The empirical results do not support the null hypothesis but indicate that the structural constraints have a significant negative effect.

Table 4. Structural Constraint Index (SCI) Decomposition

Constraint Dimension	Weight	Mean Score	Impact Contribution
Storage & Infrastructure	0.25	3.8	High
Access to Credit	0.22	4.1	High
Market Information Access	0.20	4.3	Moderate–High
Institutional Support	0.18	4.0	Moderate
Transport Cost Variability	0.15	3.6	Moderate

Source: Researcher own compilation

The findings reveal that infrastructural and financial constraints are the most binding constraints in the value chain, followed by informational and institutional constraints.

5. Discussion

The empirical results of this study clearly indicate that the value chain of the areca nut is structurally constrained market with imperfectly integrated market conditions. The discussion focuses on three related aspects: (i) marketing structure and intermediation dominance, (ii) price transmission efficiency and asymmetry, and (iii) structural constraints influencing overall value chain performance. These dimensions are interpreted based on the Value Chain Theory, the Transaction Cost Economics and the Price Transmission Theory.

5.1 Marketing Structure and Intermediation Dynamics

The findings show that there is a very fragmented marketing system controlled by middlemen and about

68% of produce is marketed through multi-graded market channels. The result corroborates the theoretical suggestion that in an agricultural system in which there is a low level of institutional coordination, the intermediaries tend to be the key actors in coordinating the sector because they are responsible for aggregation, storage and market access (Williamson, 1985). Areca nut cultivation is still dominated by traders and commission agents, restricting farmers' access to wholesale or terminal markets.

This finding mirrors the previous empirical findings in agricultural marketing systems that segmentation of supply chains raises the transaction costs and lowers farmer welfare (Barrett, 2008). The intermediary-based channels also show that there is little vertical integration and producer organizations are not well developed, which is very important for improving negotiation power and dependence on market intermediaries. Thus, the structure observed validates the hypothesis that market inefficiencies are not only incidental but are systemic in nature, and are part of the institutional structure of rural commodity markets.

5.2 Price Transmission Efficiency and Market Integration

The results of the econometric analysis confirm the long run cointegration relationship between farmgate and wholesale prices, implying that broadly speaking the areca nut markets are cointegrated. But the size of the error correction mechanism (-0.31) indicates that only a partial adjustment towards the equilibrium in the short run occurs. This suggests that the markets are not very responsive to price signals and hence the convergence process takes some time.

These are similar to the findings in spatial price transmission literature which shows that agricultural markets in developing economies have high levels of incomplete and delayed price transmission, caused by high transaction costs and imperfect information (Fackler & Goodwin, 2001). The continued existence of short-run disequilibria indicates that pricing discovery is not quite complete, presumably because intermediaries dominate the market and influence the availability of market information and timing of transactions.

As far as policy is concerned, the partial integration suggest that liberalization alone does not provide for an efficient transmission to price, but requires adequate infrastructure, market information systems and institutional governance.

5.3 Asymmetric Price Transmission and Market Power

One of the major results of this study is the existence of strong asymmetric price transmission such that the transmission of price changes from the producers to the consumers is quicker in the upward direction (0.62) than in the downward direction (0.38). Such asymmetry indicates the presence of market power in some parts of the value chain.

In theory, price changes should be symmetrical in a perfectly competitive market but in the empirical literature on agriculture, one consistently observes asymmetry in the market which can be attributed to oligopsonistic market structure, adjustment frictions and strategic pricing behaviour (Meyer & von Cramon-Taubadel, 2004). In the current context, it looks like that intermediaries might be slower in adjusting procurement prices when market prices go down, thereby taking care of their margins at the back of the producers.

This is the classical price stickiness and rent extraction behavior which is a pattern of benefiting more from an increase in price but less during price declines. This is due to the fact that this sort of asymmetry lowers the efficiency of the market and is accountable for income insecurity for smallholder producers.

5.4 Structural Constraints and Value Chain Inefficiencies

The results of the Structural Constraint Index (SCI) show that infrastructure gaps, credit market constrai-

nts, market information asymmetries, and weak institutions are important structural constraints that affect the efficiency of value chains. Of these, the most limiting factors were infrastructure and access to credit. These findings are consistent with the theories of Transaction Cost Economics, which suggests that the degree of participation in the market and efficiencies are lower as transaction costs increase owing to poor infrastructure and weak institutions (Williamson, 1985). The rural agriculture markets have poor conditions in terms of storage facilities, which compels the farmers to sell when the market is not in their favor, and limited access to credit means that farmers are unable to store produce in anticipation of better markets.

In addition, the poor information system in the market creates uncertainty in price which makes the farmers less knowledgeable in taking informed marketing decisions. This leads to an increasing reliance on middlemen which means that the system is structurally inefficient. This is similar to the situation in other agricultural commodity value chains in developing economies where value realization is greatly hampered by institutional limitations (Barrett, 2008).

5.5 Integrated Interpretation and Theoretical Implications

The results when combined provide evidence that the inefficiencies in areca nut value chain are caused by the combination of structural fragmentation, imperfect competition, and high transaction costs. The marketing structure influences the distribution of bargaining power, efficiency of market integration is measured through price transmission and the structure sets the limits for the activities of the actors.

The results from a Value Chain Theory point of view indicate that there are weak coordination mechanisms between actors, which affect the efficiency of the overall systems as a whole, and consequently value creation (Porter, 1985). The asymmetry and incomplete adjustment from a Price Transmission Theory perspective suggest that there are some distortions in the price signaling mechanism. In the interim, however, Transaction Cost Economics provides a reason why intermediaries remain the dominant actors as they are able to reduce the coordination costs, albeit at the cost of equity and efficiency.

Together these results add to the body of literature on agricultural markets' inefficiencies, and provide a clear example of the way value chain performance in perennial cash crops is influenced by the interplay of market forces and institutional and structural constraints that affect the interaction between actors.

5.6 Policy Implications

Based on the empirical evidence, there are a number of policy priorities. Strengthening producer organizations can, first, decrease the need for an intermediary and enhance their collective bargaining power. Second, investments in rural infrastructure, especially storage and transport structures, can lower the transaction costs of selling, thus averting distress sales. Thirdly, digital market information systems can help increase the transparency of the price and decrease the informational asymmetry. Lastly, producer-centric financial inclusion interventions can also improve liquidity management and minimize participation in the market, when prices are unfavorable.

6. Conclusion and Future research directions

6.1 Conclusion

The study explored empirical analysis of the areca nut value chain focusing on marketing structure, price transmission system and structural problems. Based on the Value Chain Theory, the Transaction Cost Economics and the Price Transmission Theory, the analysis offers a detailed evaluation of the way the structural organization and the market imperfections impact on the value distribution and on the efficiency results in a perennial cash crop system.

The results show that the areca nut value chain is very fragmented and dominated by intermediate actors and 68% of the areca nut production is going through marketing multi-layer value chain. This supports the structure position which indicates that producers are dependent on intermediaries due to weak market linkages and low bargaining power in line with the theory of Transaction Cost Economics (Williamson, 1985). Thus, marketing inefficiencies are not necessarily entirely behavioural, but are also structural, tied within the structural design of the value chain.

Results of the econometric analysis also confirm that prices were price-integrated between farmgate and wholesale markets in the long run but the speed of adjustment is incomplete, which suggests inefficiency in short-run price transmission. More importantly, any substantial asymmetric price transmission reveals imperfection in market functions such as faster price transmission in the upward direction than in the downward direction. This indicates an intermediary market power and non-competitive pricing behaviour as has been found earlier in commodity markets in agriculture (Meyer & von Cramon-Taubadel, 2004). Furthermore, the Structural Constraint Index (SCI) shows infrastructural deficits, credit access, the lack of market information and institutional fragmentation as important limiting factors for value chain efficiency. All these push back farmer wellbeing, inflate the transaction costs and make the farmer more reliant on the middleman. The results support, from a theoretical point of view, that the inefficiencies of the value chain are a function of the relationship of various factors which are both structural, institutional and behavioural, and not the result of a single causal mechanism.

In general, it is found that the areca nut value chain is working under structurally constrained market conditions due to imperfect competition, inadequate institutional support, and inefficient price transmission mechanism. Such inefficiencies have a great impact on the efficiency of the markets and the equitable distribution of value between actors.

6.2 Future Research Directions

This study offers solid empirical findings, but there are a number of directions where research could go. First, future research can add more factors to the analysis, using high-frequency price data to get a finer-grained picture of the dynamics of short-run volatility and speed of transmission at different layers of the market. This would allow the use of more sophisticated nonlinear models such as Threshold Vector Error Correction Models (TVECM) and Markov-switching models to better account for the regime dependent price behavior.

Second, more research is needed on the influence of digital market platforms and e-market integration on the enhanced price transparency and reduced intermediary dominance in the future. As digital agriculture technologies are adopted more and more, their impact on price discovery and market efficiency may be important policy relevant insights.

Thirdly, a comparative study between different perennial cash crops like coffee, cocoa and spices would be helpful to generalise the results and identify crop specific and system specific inefficiencies. Such comparison of the results across commodities would strengthen the external validity of the current results and add to the general agricultural economics literature.

Fourthly, future studies could include some behavioral aspects of market players such as risk preferences, negotiation behavior, and types of contracts to gain a deeper insight into the decision-making processes at the micro level of the value chains. There is a need to apply the principles of behavioral economics to value chain analysis to give a more complete picture of the inefficiencies observed.

Lastly, the use of spatial econometric methods should be taken into account in future studies to account for regional differences in price transmission and structural constraints. This would also help to identify

inefficiencies at the sub-regional level and enable policy interventions to be targeted.

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