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Chitasil Edible Coating and Price Stability of Agricultural Commodities: An Islamic Economic Law Perspective

Nur Mifchan Solichin
Universitas Islam Negeri Salatiga, Indonesia
email: nm.solichin@uinsalatiga.ac.id

Diah Nuraini
Universitas Islam Negeri Salatiga, Indonesia
email: diahn789@gmail.com

Aang Asari
Universitas Islam Negeri Walisongo, Semarang, Indonesia
email: aangasari@walisongo.ac.id

Sukron Ma'mun
Universitas Islam Negeri Salatiga, Indonesia
email: sukron.mn@uinsalatiga.ac.id

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Abstract:

Agricultural commodity price instability in perishable markets is commonly explained as a supply–demand imbalance, yet such an interpretation overlooks the structural role of time constraints in market exchange. This study examines how post-harvest technology functions not only as a productivity tool but as an economic governance mechanism within the framework of Islamic economic law. Using an empirical legal method combined with juridical–sociological analysis, field interviews were conducted with horticultural farmers in Ngablak, Magelang, and interpreted through *maqāṣid asy-syarī'ah* and *qawā'id fiqhiyyah*. The findings show that price volatility originates from forced-sale conditions caused by limited shelf

Author correspondence email: diahn789@gmail.com
Available online at: http://ejournal.iainmadura.ac.id/index.php/alihkam/

life, where farmers sell under biological time pressure rather than economic choice. The application of Chitasil edible coating extends shelf life, enabling intertemporal selling and reducing the Price Stability Index from 1.37 (indicating high volatility) to approximately 0.6 (indicating moderate fluctuation). The mechanism stabilizes prices not by controlling prices directly but by redistributing temporal risk in market transactions. From the perspective of Islamic economic law, the technology eliminates the cause of value depreciation (*raf' aḍ-ḍarar*), protects economic value (*ḥifẓ al-māl*), and restores proportional risk–benefit relations (*al-gunmu bi al-gurmi*). Furthermore, the technology functions as an institutional instrument of distributive justice by equalizing bargaining capacity without regulatory price intervention. This study concludes that post-harvest technology operates as a *maqāṣid*-based economic governance mechanism: justice is achieved through structural market design rather than contractual restriction. The contribution lies in repositioning agricultural technology from a production tool into a normative instrument of distributive justice within Islamic economic law.

Keywords:
Chitasil; Forced-Sale Equilibrium; Price stability; Distributive justice; *Maqāṣid asy-syarī'ah*

Introduction

As an agrarian country, Indonesia's economic structure is greatly influenced by the dynamics of the agricultural commodity market.[1] The main problem in this sector is not merely low production, but rather price instability, which causes uncertainty in farmers' incomes. Price fluctuations do not occur randomly, but are rooted in the structural characteristics of agricultural commodities, particularly the perishable nature of goods, simultaneous harvesting, limited storage facilities, dependence on intermediaries, and distribution and import policies that are not always in line with local production cycles. This combination of factors places farmers in a position where they must sell harvested commodities immediately after harvest to avoid

[1] Helen Nincia Setiawan, "Indonesia dengan Konsep Tradisional Agraris," *Court Review : Jurnal Penelitian Hukum* 3, no. 3 (2023): 17–20, https://doi.org/https://doi.org/10.69957/cr.v3i02.686.

product spoilage, so that prices are formed not through equal market negotiations, but through time pressure.[2]

Under these circumstances, the market mechanism does not function as a symmetrical exchange arena, but rather as a mechanism for transferring risk from actors with storage capacity to those without. Traders and distributors can delay sales until prices rise, while farmers are forced to sell when supply peaks. As a result, prices at the farmer level tend to reflect urgency costs rather than the economic value of the commodity itself. When prices increase at the consumer level, this increase does not indicate an improvement in producer welfare, but rather a transfer of value along the distribution chain. Under such conditions, market risk is not distributed evenly, but is concentrated on primary producers. From the perspective of Islamic economic law, this situation is not merely a matter of efficiency, but indicates a disturbance to the protection of economic value *(ḥifẓ al-māl)*, distributive justice *('adl)*, and the public interest *(maṣlaḥah)*.[3] In other words, price instability is a structural problem in the market mechanism, not just a normal variation in trade. Thus, the market functions not as a mechanism for the exchange of value, but as a mechanism for the transfer of risk.

This phenomenon can be seen in the highland vegetable production center in Ngablak District, Magelang, one of the main horticultural areas for cabbage (Brassica oleracea), potatoes (Solanum tuberosum L), tomatoes (Solanum lycopersicum), and carrots (Daucus carota), on the slopes of Mount Merbabu, which supplies the markets of Yogyakarta, Solo, Salatiga, Boyolali, and surrounding areas. Cabbage prices range from IDR 1,500 to IDR 8,000 per kilogram, with a deviation of around 53%. During the peak harvest period, prices even approach or fall below production costs, while during periods of high demand, prices increase significantly. On the other hand, post-harvest losses reach 30–40% due to spoilage, weight loss, and physical damage

[2] Ida Marina et al., "Dinamika Pasar Komoditas Pangan Strategis: Analisis Fluktuasi Harga dan Produksi," *Paspalum: Jurnal Ilmiah Pertanian* 12, no. 1 (2024): 160, https://doi.org/10.35138/paspalum.v12i1.700.

[3] Hidayat Rahmat, *Fikih Muamalah: Teori dan Prinsip Hukum Ekonomi Syariah*, 1st ed. (Medan: CV Tungga Esti, 2022); Wahbah Az-Zuhaili, *Fiqh Islam Wa Adilatuhu* (Damaskus: Darul Fikr, 1985), 600.

during distribution.[4] This situation leaves farmers with no room to hold onto their commodities until prices improve, as the risk of damage increases with every hour after harvest. Farmers tend to sell harvested commodities immediately after harvest due to the risk of spoilage, a condition that leads to distress selling, i.e., sales driven by time constraints rather than value agreements. Prices at the farmer level do not fully reflect product quality or production costs, but rather time pressure due to limited storage capacity and distribution access. In the supply chain, large traders have the ability to delay sales until prices rise, while farmers bear the risk of spoilage and therefore receive the lowest prices.

The introduction of chitosan food coating technology developed by PT Berkah Inovasi Kreatif Indonesia has changed the post-harvest conditions of horticultural commodities.[5] The technology, commercially known as Chitasil edible coating, refers to a chitosan-based post-harvest preservation method. In this study, the term Chitasil is used to denote the technology rather than to promote a specific commercial product. A thin layer of natural biopolymer from shrimp or crab shell waste, which is antimicrobial, can maintain product freshness longer and reduce damage during storage and distribution.[6] Mulyati's research on the Gedong Gincu mango variety shows that the application of 1.5% chitosan extends the shelf life from 7 days to 13 days with a decrease in weight loss, and similar results were found in tomatoes in various experimental studies.[7] These physical changes in commodities then have a direct impact on market transaction structures. Product durability over time gives farmers the

[4] Egadia Birru and Andi Hartik, "Harga Kubis di Magelang Anjlok, Sebagian Petani Sedekahkan Hasil Panen di Tepi Jalan," *Kompas.Com*, September 28, 2024, https://regional.kompas.com/read/2024/09/28/145823178/harga-kubis-di-magelang-anjlok-sebagian-petani-sedekahkan-hasil-panen-di.

[5] Thanh Tung Pham et al., "Application of Edible Coating in Extension of Fruit Shelf Life: Review," *AgriEngineering* 5, no. 1 (2023): 520–36, https://doi.org/10.3390/agriengineering5010034.

[6] Fakhreddin Salehi, "Edible Coating of Fruits and Vegetables Using Natural Gums: A Review," *International Journal of Fruit Science* 20, no. 2 (2020): S570–89, https://doi.org/10.1080/15538362.2020.1746730.

[7] Anggraeni Marganingsih and Eka Tarwaca Susila Putra, "Pengaruh Konsentrasi Kitosan Udang dan Kepiting Sebagai Edible Coating Terhadap Mutu dan Daya Simpan Tomat Ceri (Solanum Lycopersicum Var. Cerasiforme) Effects," *Vegetalika* 10, no. 1 (2021): 69–80, https://doi.org/10.22146/veg.57787; Salehi, "Edible Coating of Fruits and Vegetables Using Natural Gums: A Review."

ability to delay sales, so that transaction decisions are no longer determined by biological decay limits, but by price considerations.

These changes have had an impact not only on product quality but also on price formation mechanisms. The price stability index (PSI) fell from around 1.37 to ±0.6, indicating a reduction in extreme fluctuations.[8] This means that post-harvest technology acts as an instrument for transferring the timing of risk in transactions where previously the risk of spoilage was borne entirely by producers, whereas after layering some of the risk can be absorbed, thereby improving farmers' bargaining position. However, longer shelf life also has the potential to increase supply if it is not balanced by distribution arrangements, so price stability depends on how the technology is integrated with market mechanisms.

Previous studies tend to understand food coating technology as an agricultural technology innovation in preserving the shelf life and quality of commodities, rather than as an economic variable that affects price formation.[9] Meanwhile, agricultural economic studies emphasise price volatility as a consequence of seasonal production characteristics and supply chain disruptions. Keubeng, Muluh, and Kemezang show that commodity price volatility is influenced by supply imbalances and weak market stabilisation instruments at the producer level.[10] Osei et al. found that energy price fluctuations are transmitted to food commodity prices through distribution and transportation costs, so

[8] Dennis Fixler, "Incorporating Financial Services in A Consumer Price Index," in *Price Index Concepts and Measurement* (Illions, USA: University of Chicago Press, 2004), 239–72, https://doi.org/10.7208/chicago/9780226148571.003.0007.

[9] Neneng Sri Mulyati et al., "Pengaruh Pemberian Kitosan Terhadap Umur Simpan Mangga (Mangifera Indica. L.) Varietas Gedong Gincu," *Agro Wiralodra* 5, no. 2 (2022): 36–41, https://doi.org/10.31943/agrowiralodra.v5i2.71; Tagor M. Siregar and Vanessa Elysia, "Aplikasi Edible Coating dari Lidah Buaya dan Karagenan untuk Memperpanjang Umur Simpan Buah Tomat (Lycopersicum Esculentum Mill.)," *Jurnal Agroteknologi* 18, no. 01 (2024): 68, https://doi.org/10.19184/j-agt.v18i01.40104; Pham et al., "Application of Edible Coating in Extension of Fruit Shelf Life: Review"; Salehi, "Edible Coating of Fruits and Vegetables Using Natural Gums: A Review."

[10] Ivette Gnitedem Keubeng, George Achu Muluh, and Vatis Christian Kemezang, "Controlling Agricultural Product Price Volatility: An Empirical Analysis From Cameroon," *Regional Sustainability* 6, no. 2 (2025): 100215, https://doi.org/10.1016/j.regsus.2025.100215.

that primary producers face high income uncertainty even when production is stable.[11]

On the other hand, Islamic economic law studies discuss market justice through contracts and trade distribution. Rida Meilani et al. found a gap between the practice of *murābaḥah* contracts and sharia principles due to the dominance of financial institutions' interests in determining margins.[12] Kurniawan, Kara, and Misbahuddin showed that in agricultural cooperation, bargaining power imbalances affect the distribution of yields and have the potential to violate the principle of muamalah justice. [13] These three lines of research discuss the same object, but at separate levels of analysis: technology regulates the physical durability of goods, economics explains price fluctuations, and law assesses the fairness of transactions. However, there has been no study explaining how post-harvest technology can function as an instrument of economic justice within the framework of *maqāṣid asy-syarī'ah* through changes in market structure. Thus, technology has so far been understood merely as a means of production, not as a mechanism for regulating value distribution. This study positions technology as an economic institution that influences price formation, where price stability is understood as the result of risk distribution engineering, not merely the result of market policies.

Based on this gap, this study examines how Chitasil technology affects the price stability of agricultural commodities within the framework of Islamic economic law. It further analyses whether the technology can function as an instrument of distributive justice. This study positions agricultural technology not merely as a technical innovation, but as part of *maqāṣid*-based economic governance, where price stability emerges from structural value-chain engineering rather

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[11] Awura Abena Amoah Osei et al., "Does Fuel Price Volatility Induce Price Instability in The Agricultural Commodity Supply Chain? Empirical Evidence From Ghana," *Journal of Agriculture and Food Research* 17, no. May (2024): 101216, https://doi.org/10.1016/j.jafr.2024.101216.

[12] Rida Meilani Tri et al., "Analisis Faktor Pembentuk Persepsi Ketidaksesuaian Antara Praktik Akad Murabahah dan Prinsip Syariah," *Jurnal Pengembangan Bisnis dan Ekonomi* 6, no. 3 (2025): 290–97, https://ijurnal.com/1/index.php/jpbe/issue/view/239.

[13] Kurniawan, Muslimin Kara, and Misbahuddin, "Analisis Akad Kerjasama Pertanian Perspektif Fikih Muamalah di Kabupaten Enrekang," *Socius: Jurnal Sosial dan Keagamaan* 2, no. 6 (2025): 418–36, https://doi.org/10.5281/zenodo.14807694.

than regulatory intervention. Thus, the contribution of this study lies in repositioning post-harvest technology as a normative mechanism in the formation of economic justice.

Methods

This study uses empirical legal methods with a socio-legal approach combined with *istinbāṭ* (doctrinal legal reasoning). The empirical approach is used to identify the economic mechanisms that occur in the practice of horticultural commodity trading, while legal analysis is used to interpret these phenomena within the framework of Islamic economic law. Primary data were collected through in-depth semi-structured interviews conducted between January and June 2025 in the highland vegetable production centre of Ngablak Subdistrict, Magelang. A total of eight informants were interviewed, consisting of six cabbage farmers who are smallholder producers cultivating from 0.5 to 1 hectare, one local collector who acts as a middle trader purchasing directly from farmers, and one regional distributor supplying markets in Salatiga and Yogyakarta. The farmers interviewed included Widodo (45), Isom (50), Endang (52), Toni (38), Hari (47), and Wangsa (41), all of whom have been engaged in cabbage production for more than ten years. The interviews explored pricing mechanisms, storage limitations, bargaining processes, risk of product deterioration, and changes in economic behaviour following the adoption of Chitasil technology.

The analysis was conducted in three stages. *First*, the economic identification stage to find the cause of loss *('illah iqtiṣādiyyah)* in transactions. *Second*, the legal classification stage by linking these causes to *qawā'id fiqhiyyah* such as *aḍ-ḍararu yuzālu* and *al-gunmu bi al-gurmi*. *Third*, the normative construction stage to determine the legal implications of market structure changes due to technology. Thus, the research did not stop at describing practices but produced a legal reading of economic mechanisms.[14] These stages are integrated into the two-part structure of the discussion. The first and second stages are combined in the analysis of structural price formation and risk redistribution, where the economic cause of loss is identified and interpreted through *maqāṣid asy-syarī'ah* principles. The third stage is

[14] Sugiyono, *Metodologi Penelitian Kuantitatif, Kualitatif dan R&D* (Bandung: Alfabeta Bandung, 2020).

elaborated in the second section, which positions post-harvest technology as an instrument of distributive justice within *maqāṣid*-based economic governance.

Result and Discussion

Structural Transformation of Price Formation and Risk Redistribution

Before the use of Chitasil coating technology, the pricing of horticultural commodities in the research area was determined by the limited shelf life of the products. In Sucen Hamlet, farmers grow two main varieties of cabbage, namely Grand 11 with a harvest period of around 75 days and Batu cabbage with a harvest period of around 90 days, the results of which are distributed to Yogyakarta, Solo, Boyolali, Salatiga, and East Java. However, cabbage prices are highly volatile. Under normal conditions, the price reaches around IDR 8,000/kg for good quality and IDR 3,000/kg for medium quality, but during peak harvest or when quality declines due to extreme weather, the price can drop to IDR 1,500–IDR 2,000/kg, even lower than the distribution costs, so some farmers choose to donate their harvest. A similar pattern occurs with other commodities such as carrots, tomatoes, and potatoes, which show a wide price range between harvest seasons and periods of supply shortages. These fluctuations are directly related to the biological nature of post-harvest products. Vegetables are susceptible to bacterial and fungal attacks and oxidation, which accelerate wilting, discolouration, and weight loss during distribution, so any delay in sale increases the risk of economic loss. Without adequate storage facilities, farmers must sell immediately after harvest to avoid quality deterioration. During simultaneous harvests, supply increases suddenly while the market's absorption capacity remains relatively constant, causing prices to fall to IDR 1,500–IDR 2,000/kg. This condition indicates the formation of a forced-sale equilibrium mechanism, which is a situation where supply does not reflect the economic decisions of producers but is forced by the biological limits of the commodity.[15] This theoretical description corresponds to the

[15] Domenico Di Gangi, Fabrizio Lillo, and Davide Pirino, "Assessing Systemic Risk Due to Fire Sales Spillover Through Maximum Entropy Network Reconstruction," *Journal of Economic Dynamics and Control* 94 (2018): 117–41, https://doi.org/10.1016/j.jedc.2018.07.001; Scad Independent, "Indonesian as a Regional Lingua Franca in the Asean Economic Community," *Jurnal Ilmiah Peuradeun*

experience of farmers in Sucen Hamlet. A farmer, Widodo, a cabbage producer cultivating approximately 0.7 hectares, stated during the interview,

> "If we don't sell on the same day, the leaves start to wilt. Even if the price is low, we have no option but to release it immediately."[16]

Another farmer, Endang, a smallholder producer supplying the Salatiga market, indicated that traders are aware of farmers' limited storage capacity and tend to delay purchasing until harvest peaks, allowing them to offer lower prices under conditions of producer dependency.[17] These testimonies confirm that the forced-sale mechanism is not merely a theoretical construct but a structural condition embedded in everyday market practice. This structural condition is further observable in the actual production environment of farmers in Ngablak. As illustrated in Figure 1, cabbage cultivation takes place in open highland fields with synchronized harvesting patterns. The scale and simultaneity of production visually demonstrate how supply concentration occurs within a limited time frame.

Figure 1. Cabbage Fields and Vegetable Harvests

Figure 1 illustrates the production setting in which harvesting occurs within a concentrated time frame and under open-field

14, no. 1 (2026): 551–72, https://doi.org/10.26811/peuradeun.v14i1.2562; Nurliana, Ikhwanuddin Abdul Majid, and Miftah Ulya, "Rewriting Husband-Wife Roles in Society 5.0: A Fiqh Perspective on Family Resilience," *PETITA: Jurnal Kajian Ilmu Hukum dan Syariah* 10, no. 2 (2025): 863–83, https://doi.org/10.22373/petita. v10i2.810.

[16] Widodo, Farmers Mount Merbabu, *Interview,* Magelang, 2025.

[17] Endang, Farmers Mount Merbabu, *Interview,* Magelang, 2025.

conditions. The visual depiction highlights the scale of output generated simultaneously across farmers, indicating the structural concentration of supply at the production stage. This condition forms the empirical backdrop of the pricing mechanism previously described, where biological timing strongly shapes market participation. The figure, therefore, contextualizes the structural environment in which price volatility emerges.

Chitasil technology changes the core constraint in this market mechanism, not by setting prices, but by extending the time available for transactions. Previously, limited shelf life functioned as a binding temporal constraint that forced farmers to sell immediately after harvest. By extending marketability and reducing post-harvest losses by 30–40%, the technology reduces this urgency and enables farmers to delay sales according to market conditions. This shift alters the timing of supply entry into the market. Prior to its adoption, supply was concentrated within a narrow harvest window, creating temporal spikes that drove prices downward, followed by sharp increases during periods of scarcity. After the application of Chitasil, supply becomes more temporally distributed, allowing commodities to be released gradually in response to market demand. As a result, price formation shifts from a forced-sale equilibrium, where prices are determined by biological time pressure, to a more intertemporal adjustment mechanism. In this sense, the technology functions as a structural stabilisation mechanism rather than as a direct instrument of price control.

This temporal redistribution of supply is accompanied by a shift in bargaining power among market participants. When the risk of spoilage is no longer borne entirely by farmers, buyers can no longer determine prices unilaterally based on time pressure. Farmers gain a reservation price through the ability to delay transactions, resulting in a more balanced exchange relationship.[18] In other words, the technology worked to redistribute the time risk from farmers to the market, rather than simply improving product quality. This change in mechanism was then quantitatively reflected in the Price Stability Index (PSI), which measures the level of price dispersion over a period.

[18] Guillaume Coqueret, Bertrand Tavin, and Yuxin Zhou, "Sustainability in Commodity Markets," *Journal of Banking & Finance* 184 (2026): 107599, https://doi.org/10.1016/j.jbankfin.2025.107599.

Before the use of Chitasil, cabbage prices ranged from IDR 1,500/kg to IDR 8,000/kg, with an average of IDR 4,750/kg.

$$\text{PSI}=\frac{\text{Price Max.}-\text{Price Min}}{\text{Prive Average}}=\frac{8000-1500}{4750}=1.37$$

A PSI value above 1 indicates very high price dispersion within a defined observation period. In this study, the PSI was calculated based on weekly farm-gate cabbage prices over a six-month harvest cycle before and after the application of Chitasil (January–June 2024 as the pre-technology period and January–June 2025 as the post-technology period). During the pre-technology period, prices fluctuated between IDR 1,500/kg and IDR 8,000/kg, resulting in a PSI value of 1.37. After the implementation of Chitasil, observed over the subsequent comparable six-month harvest cycle, prices were concentrated within the range of IDR 3,000–IDR 5,000/kg, with an average of around IDR 4,000/kg, causing the PSI to decline to approximately 0.6.

This decrease in volatility indicates that price stability is not the result of pricing policies, but rather a change in the ability of market participants to hold back supply. Thus, Chitasil does not directly control prices, but rather changes the mechanism of price formation through the engineering of time risk distribution in market transactions. This structural transformation raises a normative question: how should such changes be understood within Islamic Economic Law? If price stability emerges from market design rather than contractual modification, the object of legal evaluation shifts from contracts to exchange structures.

Islamic economic law studies have tended to place justice at the level of contracts. The validity of transactions is measured by the absence of usury, *garar*, fraud, and other manipulative elements. As long as these elements are not found, transactions are considered valid and fair. This approach is reflected in many Islamic economic studies that place sharia compliance as the main indicator of economic justice, particularly through the prohibition of usury and clarity of the object of exchange.[19] Within this framework, economic supervision is directed

[19] Zohora Azmin Shompa, Mohamed Aslam Akbar, and Hazwani Mohd Mohadis, "Harmonizing Maqasid Al-Shari'ah with Sustainable Waste Management Practices: A Conceptual Framework For Principles and Implementation," *International*

more towards contractual compliance than towards the distribution of economic results after the transaction takes place.

However, developments in *maqāṣid asy-syarī'ah* studies show that formal compliance does not necessarily result in substantive economic justice. Several studies have assessed that modern Islamic economic practices often meet legal standards but do not always have an impact on welfare distribution or social stability.[20] Studies measuring performance based on *maqāṣid asy-syarī'ah* also show that indicators of justice cannot be measured solely by the form of the contract, but rather by the distribution of economic benefits and social impact.[21] The phenomenon of horticultural commodities illustrates this situation. Transactions are valid, prices are agreed upon without formal coercion, but one party still suffers repeated losses. Injustice arises not from contractual defects, but from the market mechanism itself.

In recent economic studies, prices can be formed due to liquidity pressures or structural constraints, rather than the fundamental value of goods.[22] In markets for perishable commodities, limited shelf life creates time pressures that force producers to sell their harvested commodities before optimal prices are achieved. Laura shows that increased storage capacity or post-harvest technology can change producers' bargaining position through the redistribution of time risk in the supply chain. This means that price disparities are not the result of flawed contracts, but rather the result of an unbalanced

Journal of Islamic and Middle Eastern Finance and Management 18, no. 1 (2025): 142–65, https://doi.org/10.1108/IMEFM-02-2024-0061.

[20] Alija Avdukic and Mehmet Asutay, "Testing the Development Impact of Islamic Banking: Islamic Moral Economy Approach to Development," *Economic Systems* 49, no. 2 (2025): 101229, https://doi.org/10.1016/j.ecosys.2024.101229; Achmad Bashori, Khairil Umami, and Soleh Hasan Wahid, "Maqasid Shariah-Based Digital Economy Model: Integration, Sustainability and Transformation," *Malaysian Journal of Syariah and Law* 12, no. 2 (2024): 405–25, https://doi.org/10.33102/mjsl.vol12no2.647.

[21] Elyanti Rosmanidar et al., "Is It Fair To Assess the Performance of Islamic Banks Based on the Conventional Bank Platform?," *Ulul Albab: Jurnal Studi Islam* 23, no. 1 (2022): 1–21, https://doi.org/10.18860/ua.v23i1.15473; Qodariah Barkah et al., "Legal Transformation of Indonesian Sharia Banks Towards Digital Banking in the Era of Industrial Revolution 4.0," *Al-'Adalah : Jurnal Syariah dan Hukum Islam* 21, no. 2 (2024): 347–70, https://doi.org/10.20884/1.jdh.2011.11.edsus.263.1.

[22] Di Gangi, Lillo, and Pirino, "Assessing Systemic Risk Due to Fire Sales Spillover Through Maximum Entropy Network Reconstruction."

market design. In this case, Islamic economic law needs to be reconstructed from merely supervising the legality of contracts to analysing market structures that produce systematic losses. When transactions are formally valid but result in unilateral losses due to time pressure, the object of legal study is no longer the contract, but the economic system itself.

Modern economic literature explains this situation as constraint-driven pricing, a condition in which prices are determined by structural pressures faced by sellers, rather than solely by the value of the goods. In the case of perishable commodities, limited shelf life creates time pressure that forces producers to sell the commodities before optimal prices are reached.[23] Research on the fruit and vegetable supply chain shows that losses and price fluctuations are strongly correlated with storage conditions and supply volume.[24] A study of the chilli value chain also found that volatility is mainly triggered by seasonal production and post-harvest losses, rather than transaction defects.[25] In the pricing model for fresh produce, pricing decisions must even adjust for product age because unsold goods will be discarded. Distribution time dynamics further exacerbate these fluctuations. Thus, price disparities arise from the design of risk distribution, not from contract violations. On that basis, the object of legal analysis is no longer limited to the contract, but also to the cause of loss *('illah iqtiṣādiyyah)* behind the transaction. Field findings show that farmers sell their harvested commodities not because of economic choice, but because of limited selling time. Commodities lose value every hour after harvest, so the price received is below its economic value. Thus,

[23] Andrés Mauricio Paredes-Rodríguez, Juan Pablo Orejuela-Cabrera, and Juan Carlos Osorio-Gómez, "Design of a Short Fresh Food Supply Chain Considering Risks From Harvest Conditions and Price Volatility," *Results in Engineering* 28 (2025): 108113, https://doi.org/10.1016/j.rineng.2025.108113; Rumpa Chowdhury et al., "Supply-Disposition Storage of Fresh Fruits and Vegetables and Food Loss in the Canadian Supply Chain," *Ecological Indicators* 170 (2025): 113063, https://doi.org/10.1016/j.ecolind.2024.113063.

[24] Yanti Nuraeni Muflikh, Carl Smith Colin Brown, and Nunung Kusnadi, "Integrating System Dynamics to Value Chain Analysis to Address Price Volatility in the Indonesian Chilli Value Chain," *Food Policy* 128, no. 2 (2024).

[25] Xiongzhi Wang and Fangling Tang, "Dynamic Pricing and Inventory Control for Fresh Agricultural Products Under Dual Channel," *Journal of Management Science and Engineering* 11, no. 1 (2026): 37–73, https://doi.org/10.1016/j.jmse.2025.11.002.

the *'illah* of loss is not the contract, but the time pressure that creates a forced-sale condition.[26]

The principle of *ḥifẓ al-māl* is then interpreted as the protection of economic value, not merely the protection of ownership.[27] The value of commodities declines not because of the quality of production, but because of market structures that erode value before an equivalent exchange takes place. Financial economics research shows that assets sold under liquidity pressure lose value not because their quality changes, but because market mechanisms force price discounts. When technology extends shelf life, that value is protected from forced depreciation.[28] Asset protection is achieved through value stabilisation, not through transaction cancellation.

The principle of *aḍ-ḍararu yuzālu* broadens this interpretation. Losses do not always arise from individual actions, but also from the structure of exchange mechanisms. In the horticultural market, the distribution structure places the risk of damage entirely on producers or farmers. Commodities have biological limits while prices are market-driven, making time a binding constraint on transactions. Farmers must release their harvest before quality deterioration reduces its value, whereas buyers can postpone purchasing decisions until prices decline. During peak harvest periods, farmers tend to accept prevailing market prices due to their inability to delay sales, indicating

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[26] Ibrahim Ibn Musa, *Al Muwafaqat Fi Ushul Al Shari'ah* (Beirut, Lebanon: Darul Ma'rifah, 1968); Feng Yao and Manuel A. Hernandez, "When Prices Spike: Identifying Excessive Volatility in Fertilizer Markets," *Economics Letters* 259 (2026): 112758, https://doi.org/10.1016/j.econlet.2025.112758; Moh. Hamzah, et al, "The Transformation of Electronic Mediation: A Legal Innovation in the Sharia Economic Dispute Resolution," *Juris: Jurnal Ilmiah Syariah* 25, no. 1 (2026): 15–27, https://doi.org/10.31958/juris.v25i1.15856.

[27] Muhammad Al Tahir Ibn Ashur, *Ibn Ashur Treatise on Maqashid Al-Shari'ah* (London: International Institute of Islamic Thought, 2013); Ending Solehudin et al., "Al-Risalah Transformation of Shariah Economic Justice : Ethical and Utility Perspectives in the Framework of Maqashid Shariah," *Al-Risalah: Forum Kajian Hukum dan Sosial Kemasayarakatan* 24, no. 1 (2024): 101–15, https://doi.org/10.30631/alrisalah.v24i1.1467; Lukis Alam et al., "Negotiating Ethnic and Religious Identities : Indonesian Chinese Muslims in Sharī'ah Compliant Business," *Ijtihad: Jurnal Wacana Hukum Islam dan Kemanusiaan* 25, no. 1 (2025): 29–54, https://doi.org/10.18326/ijtihad.v25i1.29-54.

[28] Paredes-Rodríguez, Orejuela-Cabrera, and Osorio-Gómez, "Design of a Short Fresh Food Supply Chain Considering Risks From Harvest Conditions and Price Volatility."

that transactions are driven by time constraints rather than bargaining power.

This condition shows that losses arise not from contractual violations but from structural time pressure embedded in the exchange mechanism. Within this framework, *ḍarar* is not an isolated act but a systemic condition that repeatedly erodes one party's asset value. Because the source of loss lies in temporal constraints, its elimination requires removing the underlying pressure rather than cancelling the transaction. Post-harvest technology extends shelf life so that the risk of time is no longer one-sided. Thus, the principle of *raf' aḍ-ḍararu* is fulfilled through changes in the conditions of exchange.

The principle of *al-gunmu bi al-gurmi* then explains the change in profit distribution. This rule requires that the party bearing the risk is entitled to commensurate potential profits. Prior to technological intervention, producers bore all the risks of damage without the ability to determine the time of sale, while buyers profited from price reductions due to time pressure. After the shelf life increased, producers had the option of delaying sales so that the time risk was shared. This change created a reservation price and strengthened farmers' bargaining position. The price stability that emerged was not due to equal profits, but due to the alignment between the risks borne and the benefits obtained. Thus, fairness lies in balanced risk distribution rather than equal outcomes.[29]

This reconstruction places *maqāṣid asy-syarī'ah* not as ethical legitimacy, but as a legal instrument. There is no usury, *garar*, or fraud, but systematic losses still occur. This situation includes *ẓulm an-niẓām* (structural injustice), which is injustice arising from market structures. *Fiqhiyyah* rules direct the elimination of the cause.[30] While elimination

[29] Jasser Auda, *Maqashid Al-Shariah as Philosophy of Islamic Law A Systems Approach* (London: London Office, 2007); Nina Nurani, "Intellectual Property Rights Law Reform Based on Maqāṣid Al-Sharī'ah as a Model for Green Business-Based Creative Industry Protection to Support Sustainable Development," *De Jure: Jurnal Hukum dan Syar'iah* 18, no. 1 (2026): 1–32, https://doi.org/10.18860/j-fsh.v18i1.40840.

[30] Ashur, *Ibn Ashur Treatise on Maqashid Al-Shari'ah*; Bambang Iswanto and Miftah Faried Hadinatha, "Sharia Constitutionalism: Negotiating State Interests and Islamic Aspirations in Legislating Sharia Economic Law," *Ahkam: Jurnal Ilmu Syariah* 23, no. 1 (2023): 235–58, https://doi.org/10.15408/ajis.v23i1.32899; Nurul Hikmah et al., "The Dynamics of Backpacker Umrah within the Framework of Maqashid Asy-Syariah and Sociology of Law," *Nurani: Jurnal Kajian Syari'ah dan Masyarakat* 25, no. 2 (2025): 377–98, https://doi.org/10.19 109/nurani.v25i2.28 557.

is usually carried out through *tas'īr* (state-imposed price regulation) by the authorities, in this case, the cause of injustice is eliminated through technology that removes time pressure. Thus, the intervention does not take the form of price regulation, but rather the engineering of exchange mechanisms. *Maqāṣid asy-syarī'ah* ultimately functions as a structural analysis: the law not only assesses transactions, but also directs system improvements when the system produces repeated losses. Post-harvest technology becomes an instrument of ijtihād muʿāmalah because it eliminates the *'illah* of loss and restores the balance of value in economic exchange.

Technology as an Instrument of Distributive Justice

Field findings indicate that the adoption of Chitasil technology did not increase production volume but altered farmers' bargaining capacity. Several farmers reported that after extending shelf life, they were no longer compelled to accept the first price offered by traders. As explained by Isom, a 50-year-old farmer with more than ten years of production experience,

> "Before using the coating, we sold it immediately, even if the price was low. Now we can wait one or two days. If the price is too low, we hold it."[31]

This testimony demonstrates that the transformation occurred at the level of exchange relations rather than production volume. Farmers gained the ability to delay sales, which reduced their dependence on traders during peak harvest. The economic change, therefore, lies not in increased output but in the redistribution of decision-making power within the transaction process.

In modern agricultural economics, technological innovation is generally understood as a means of increasing productivity. Its success is measured by increased output, reduced yield losses, or production cost efficiency. However, food value chain literature demonstrates that efficiency gains do not automatically translate into equitable welfare distribution. Actors controlling storage and timing capture a larger share of value than producers. In such circumstances, new technologies may either reinforce inequality or redistribute value, depending on

[31] Isom, Farmers Mount Merbabu, *Interview,* Magelang, 2025.

how they alter market relations. In the Ngablak case, the technology did not merely improve product durability. It shifted control over transaction timing from buyers alone to both parties. This redistribution effect is also reflected in farmers' income perceptions. Farmers also reported that even small price increases significantly improved total income when accumulated across harvest volume, reflecting reduced value erosion during exchange.

Although the price difference per kilogram appears modest, farmers emphasized that across total harvest volume the cumulative impact significantly improved their net returns. The change in income did not arise from higher production, but from reduced value erosion during exchange. Commodities retained their economic value because they were no longer forced into the market at biologically determined moments. This finding shows that technological intervention influences welfare distribution through structural modification of exchange conditions. From the perspective of modern distributive justice theory, inequality is not merely a matter of unequal outcomes but of unequal access to economic opportunities embedded within market structures. Institutional economics emphasizes that distributional imbalance often originates from asymmetry in control over critical resources, including time, information, and storage capacity. In agricultural value chains, time functions as a strategic economic resource that determines when and under what conditions commodities enter the market. When this temporal control is concentrated in downstream actors, value capture becomes structurally biased. Therefore, distributive justice must be understood not only as a question of income allocation but as a function of how value chain governance allocates decision-making power among actors.

Within the framework of value chain governance, this transformation indicates a shift from buyer-driven coordination towards a more balanced relational structure. Prior to technological intervention, traders effectively governed the chain by controlling the timing of transactions, thereby determining price formation under conditions of producer dependency. The introduction of post-harvest technology weakens this unilateral control by enabling producers to participate in temporal decision-making. As a result, governance within the value chain becomes less hierarchical and more distributed, allowing value to be negotiated rather than imposed. This

reconfiguration highlights that technological intervention can alter governance structures without formal institutional reform.

Institutional economics further explains that welfare distribution is shaped not only by formal regulations but also by structural conditions that determine who possesses economic choice. Access to storage time functions as an institutional resource. When only one party controls timing, benefit distribution becomes asymmetric. Empirical studies on price volatility confirm that control over transaction timing strongly influences producer income inequality.[32] In this context, post-harvest technology operated as a mechanism for equalizing economic opportunity. Farmers no longer sold solely because of biological limitations, but based on economic considerations. This structural adjustment was also acknowledged by actors in the distribution chain. A regional distributor supplying markets in Yogyakarta and Salatiga stated,

> "The price is more stable now. We still trade as usual, but the situation is not as extreme during harvest peaks."[33]

This indicates that redistribution did not eliminate intermediaries. Instead, it moderated bargaining asymmetry and reduced extreme volatility. Redistribution occurred through internal structural adjustment within the market mechanism, not through external price regulation. This finding positions post-harvest technology as a form of non-state economic governance. Unlike conventional policy instruments such as price controls (*tas'īr),* subsidies, or distribution regulations, which operate through external intervention, technological mechanisms function by restructuring internal market conditions. Price control policies may stabilize prices temporarily but risk distorting supply incentives, while subsidies often depend on fiscal capacity and administrative effectiveness.[34] In contrast, post-harvest technology alters the structural parameters of exchange, particularly the distribution of temporal risk, without

[32] Paredes-Rodríguez, Orejuela-Cabrera, and Osorio-Gómez, "Design of a Short Fresh Food Supply Chain Considering Risks From Harvest Conditions and Price Volatility"; Keubeng, Muluh, and Kemezang, "Controlling Agricultural Product Price Volatility: An Empirical Analysis From Cameroon."

[33] Toni, Farmers Mount Merbabu, *Interview,* Magelang, 2025.

[34] {Formatting Citation}

disrupting market signals. As such, governance is achieved not through coercive regulation but through the reconfiguration of constraints that shape market behaviour.

In Islamic economic law, distributive justice is not assessed solely by contractual validity. A transaction may be free from *ribā, garar*, or fraud, yet still produce systematic inequality when one party lacks meaningful choice.[35] Such a condition reflects structural injustice, where benefits arise not from productive contribution but from dominance in exchange conditions. In the Ngablak case, prior to technological adoption, producers bore time risk without corresponding control over transaction timing. After shelf life was extended, producers gained a reservation price and the ability to negotiate. This transformation aligns with the *maqāṣid* conception of justice articulated by Ibn ʿĀshūr and Auda, where justice requires proportionality between risk and benefit.[36] The principle of *al-gunmu bi al-gurmi*, a foundational rule in Islamic economic law that establishes that gain is justified only when accompanied by risk-bearing, requires that profit corresponds to risk participation. By restoring the capacity to delay transactions, technology redistributed temporal risk more proportionally. Justice here does not require equal income outcomes, but balanced exchange conditions. This conception of balance reflects a broader understanding of justice (ʿ*adl*) within the maqāṣid *asy-syarī'ah* framework, where fairness is achieved through proportionality in economic relations rather than uniformity of results. Justice is realized when no party is structurally compelled into a disadvantageous exchange due to constraints beyond their control. In this context, the removal of time pressure restores the equilibrium necessary for voluntary and value-based transactions. Furthermore, the principle of maṣlaḥah extends this analysis to the systemic level, where the stability of producer income contributes to the sustainability of supply and the

[35] Rosmanidar et al., "Is It Fair To Assess the Performance of Islamic Banks Based on the Conventional Bank Platform?"; Rahmat, *Fikih Muamalah: Teori dan Prinsip Hukum Ekonomi Syariah*.

[36] Auda, *Maqashid Al-Shariah as Philosophy of Islamic Law A Systems Approach*; Ashur, *Ibn Ashur Treatise on Maqashid Al-Shari'ah*; Dede Kania, "Can Penal Mediation Solve Domestic Violence? Insights From Islamic Law," *Jurnal Litigasi* 25, no. 2 (2024): 172–87, https://doi.org/10.23969/litigasi.v25i2. 13320; Rahma Octaviani, Pas Ingrid Pamesti, and Bagas Heradhyaksa, "Review of Equity Crowdfunding Practices through Santara.Id in the Perspective of Islamic Economic Law," *Al-Ahkam* 31, no. 2 (2021): 161–82, https://doi.org/10.21580/ ahkam.2021.31.2.9014.

broader welfare of society. Thus, distributive justice is not confined to individual transactions but operates as a structural condition that sustains economic continuity.

In addition, this mechanism can be interpreted through the principle of *sadd aż-żarā'i'*, which emphasizes the prevention of pathways leading to harm. The forced-sale condition observed in perishable commodity markets represents a recurring pathway through which value erosion and distributive imbalance occur. By extending shelf life, post-harvest technology effectively blocks this pathway, preventing the emergence of structural injustice before it materializes in transactions. In this sense, technology does not merely correct outcomes but intervenes at the level of causal mechanisms, aligning market processes with the preventive orientation of Islamic legal principles. Moreover, distributive justice within the *maqāṣid* framework encompasses systemic balance. Stabilized producer income supports production sustainability, while moderated price fluctuations protect consumers from extreme spikes. Food security research demonstrates that stability in producer-level value distribution correlates with long-term supply stability. Thus, the benefits of technological intervention extend beyond individual farmers. Producers maintain viability, traders continue their distributive function, and consumers experience more predictable prices. This reflects the realization of maṣlaḥah at the structural level. Therefore, technology in this context functions not merely as a production tool but as an economic institution that restructures exchange relations. Unlike *tas'īr* (state-imposed price regulation), which operates externally, post-harvest technology works internally by altering the temporal structure of transactions. It does not directly distribute profits; it creates conditions under which proportional distribution becomes possible. Within the framework of Islamic economic law, this positions technology as part of *maqāṣid*-based economic governance, where justice is achieved through institutional design rather than contractual restriction.

Conclusion

This study concludes that price instability in horticultural commodities originates not merely from supply–demand imbalance but from the temporal structure of exchange that forces farmers to sell harvested commodities under biological time pressure. The adoption

of Chitasil post-harvest technology extends shelf life and restructures the timing of transactions, shifting price formation from a forced-sale equilibrium to a more intertemporal adjustment mechanism. As a result, price stability emerges through the redistribution of temporal risk rather than through regulatory price intervention. From the perspective of Islamic economic law, this transformation demonstrates that injustice may arise from market structure rather than contractual defects. By eliminating the cause of loss *('illah iqtiṣādiyyah)* rooted in time pressure, the technology fulfills the principles of *ḥifẓ al-māl, raf' aḍ-ḍararu,* and *al-gunmu bi al-gurmi*. Therefore, post-harvest technology operates not merely as a production tool but as a maqāṣid-based economic governance mechanism that achieves distributive justice through institutional design.

This study is limited to one horticultural production area and one type of post-harvest technology, so generalization across commodities and supply chains is limited. The analysis also focuses on changes in pricing mechanisms and risk distribution without measuring the long-term impact on broader market structures, such as wholesaler behavior or integration with national distribution policies. Furthermore, the study uses a qualitative-juridical approach, thus failing to quantitatively test the econometric model of the relationship between technology and price stability across various production seasons. Future research could expand the sample to include various perishable commodities and different distribution regions to test the consistency of risk redistribution mechanisms. Longitudinal quantitative studies are also needed to measure the impact of technology on long-term price volatility and the welfare of supply chain actors. From an Islamic economic law perspective, further research could develop the *maqāṣid* framework at the public policy level by examining how technological innovation can be integrated with market regulatory instruments, thus forming an economic governance model that comprehensively integrates institutional design, technology, and sharia norms.

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