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Cold-Chain Infrastructure Gaps and Post-Harvest Losses in Louisiana's Crawfish Industry: Implications for Revenue Generation and Employment

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ABSTRACT
Louisiana remains the dominant producer of crawfish in the United States, supplying over 95 percent of national output from a combination of farmed systems and natural freshwater ecosystems. Although the crawfish sector has long served as a cornerstone of the state's agricultural economy, persistent post-harvest inefficiencies continue to constrain its full economic potential. Among the most pressing but insufficiently addressed constraints is the weakness of cold-chain infrastructure, encompassing refrigerated storage, cold transport networks, and temperature-regulated handling and processing facilities. Due to the extreme perishability of crawfish, breakdowns in cold-chain management result in significant spoilage, declining product quality, unstable market prices, and limited access to high-value domestic and export markets. At a time when employment expansion and revenue diversification are critical development goals for Louisiana, this study investigates the role of cold-chain infrastructure deficiencies in driving post-harvest losses within the state's crawfish industry. The research draws on survey data collected from 200 crawfish producers, processors, and distributors operating across major producing parishes in Louisiana. A binomial logistic regression framework is employed to evaluate the perceived influence of cold storage availability, refrigerated transportation, market distance, and government intervention on post-harvest loss outcomes. The empirical results indicate that limited access to cold storage facilities, inadequate refrigerated logistics, elevated energy costs, and insufficient public sector support significantly heighten the probability of post-harvest losses. The study concludes that strategic investments in cold-chain systems would substantially reduce product losses, improve price stability, generate new jobs in logistics and storage services, and enhance state tax revenues and export performance. Consequently, the study advocates for coordinated public–private partnerships, targeted subsidies for small and medium-scale operators, and comprehensive cold-chain development policies to strengthen the long-term competitiveness of Louisiana's crawfish industry.
Keywords: *Cold-chain infrastructure, Employment, Post-harvest losses, Revenue, Crawfish, Logistic regression, Employment, Revenue, Transport, Storage*
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INTRODUCTION:

The challenges of sustainable revenue generation and employment expansion continue to occupy a central position in Louisiana's public policy agenda, particularly in light of recurring fiscal pressures, uneven regional development, and persistently high levels of rural unemployment. Despite the state's abundance of natural and cultural resources, Louisiana has consistently ranked near the bottom among U.S. states in key indicators such as economic opportunity, public health, and quality of life, underscoring the urgency for targeted sectoral reforms and economic diversification strategies (U.S. News & World Report, 2019). In response, policymakers and development scholars have increasingly emphasized the strategic role of agriculture and fisheries-based industries as vehicles for inclusive growth, employment absorption, and resilience against revenue volatility associated with extractive sectors such as oil and gas (FAO, 2019; World Bank, 2020).

Within this context, the crawfish industry stands out as one of Louisiana's most significant comparative advantages (see Figure 1 for more details). Deeply embedded in the state's ecological systems, culinary traditions, and regional identity, crawfish production has evolved into the largest freshwater crustacean aquaculture industry in the United States. Louisiana consistently supplies between 90 and 95 percent of total

domestic crawfish output, with annual production exceeding 100 million pounds harvested from both aquaculture farms and natural waterways (Louisiana Crawfish Promotion and Research Board [LCPRB], 2020). Beyond its cultural importance, the industry supports thousands of livelihoods across farming, wild harvesting, processing, transportation, marketing, food service, and tourism-related activities, contributing substantially to rural economies across southern Louisiana. Despite its scale and importance, the crawfish industry remains constrained by systemic inefficiencies that erode value along the supply chain. One of the most critical challenges is the prevalence of post-harvest losses, which significantly reduce the volume and quality of crawfish available for sale. Post-harvest losses are particularly severe in fisheries and aquaculture systems due to the biological sensitivity of aquatic products to temperature, handling practices, and time delays between harvest and consumption (Kader, 2005; FAO, 2020). Crawfish, in particular, are highly perishable and require rapid cooling immediately after harvest to maintain freshness, prevent microbial growth, and preserve market value. When proper temperature control is absent, product quality deteriorates quickly, leading to shortened shelf life, price discounts, and outright spoilage.

A growing body of global literature identifies weak cold-chain infrastructure as a leading driver of post-harvest losses in perishable food systems, especially in developing and resource-dependent regions (FAO, 2014; World Bank, 2011). Cold-chain infrastructure encompasses the interconnected network of on-farm cooling systems, ice plants, cold storage facilities, refrigerated transportation, energy supply, and temperature-monitoring technologies required to maintain product integrity from harvest through processing, distribution, and final consumption (WHO, 2015). Inadequate cold-chain systems not only increase food waste but also limit producers' ability to access distant urban markets and meet the stringent quality and safety standards required for export trade (FAO, 2019).

In Louisiana's crawfish industry, empirical research has largely concentrated on production techniques, marketing strategies, pricing dynamics, and value-added processing, while the role of cold-chain infrastructure has received comparatively limited scholarly attention. This omission is significant, given that weaknesses in refrigeration, storage capacity, and transport logistics can negate gains achieved through increased production or improved marketing. Moreover, inadequate cold-chain systems disproportionately affect small and medium-scale producers, who often lack the capital to invest in private refrigeration infrastructure and are more vulnerable to energy costs and logistical constraints (World Bank, 2020). Addressing cold-chain inefficiencies is therefore not only a matter of reducing food losses but also a strategic pathway for enhancing employment creation, stabilizing farm incomes, improving price competitiveness, and expanding export opportunities. Investments in cold storage facilities, refrigerated transport services, and energy-efficient cooling technologies have the potential to generate new jobs in logistics, processing, and infrastructure maintenance, while simultaneously increasing tax revenues and strengthening rural economies (FAO, 2014; FAO, 2020). For a state seeking to improve its economic resilience and reverse declining development indicators, strengthening cold-chain systems within its flagship crawfish industry represents a timely and high-impact policy intervention.

Against this backdrop, the present study investigates the extent to which cold-chain infrastructure gaps contribute to post-harvest losses in Louisiana's crawfish industry. Specifically, the study examines crawfish farmers', processors', and distributors' perceptions regarding access to cold storage facilities, availability of refrigerated transportation, distance to major markets, energy costs, and the role of government support in mitigating post-harvest losses. By employing a binomial logistic regression framework, the study provides empirical evidence on the determinants of post-harvest losses and offers policy-relevant insights to guide public and private investment decisions aimed at enhancing the long-term sustainability and competitiveness of Louisiana's crawfish sector.

LITERATURE REVIEW

Figure 1:

Image of Fresh Water Crawfish

Source: LSU AgCenter (2016)

Figure 1 presents an image of freshwater crawfish, highlighting the species that forms the backbone of Louisiana's crawfish industry. The visual underscores the importance of this aquaculture product in the state's economy, culture, and food systems. Crawfish are highly perishable, and their quality is sensitive to handling and storage conditions, which directly links to post-harvest losses. The image reinforces the necessity of cold-chain infrastructure—from immediate post-harvest cooling to refrigerated transport—to maintain product freshness, reduce spoilage, and support both local markets and export potential. By visualizing the product, the figure contextualizes the critical need for improved storage, logistics, and handling practices in sustaining Louisiana's crawfish sector.

Overview of Post-Harvest Losses in Fisheries and Aquaculture

Post-harvest losses (PHLs) in fisheries and aquaculture represent a persistent global challenge, particularly in resource-dependent regions where storage, handling, and transportation infrastructures are underdeveloped. According to the Food and Agriculture Organization (FAO, 2016), losses in fishery products can range from 10% to over 35% of total production, with the magnitude depending on post-harvest handling practices, temperature management, and market access. Such losses have both economic and social implications, reducing producer incomes, limiting household food availability, and undermining national food security objectives (Gustavsson et al., 2011).

In freshwater crustaceans like crawfish, the situation is particularly critical due to the species' high perishability, rapid metabolic rate, and sensitivity to temperature and oxygen deprivation (Oluwade & Adu-

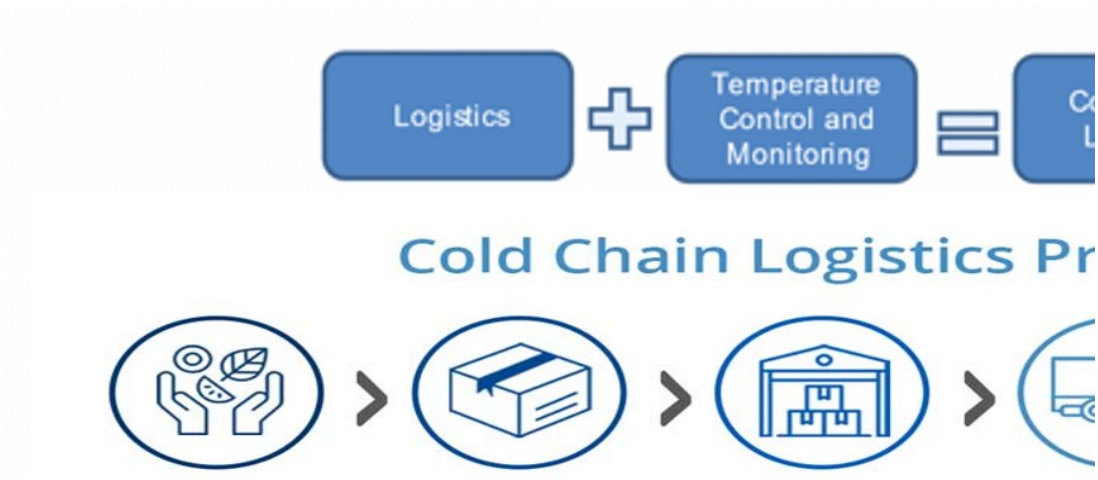
Frimpong, 2018). Studies indicate that even brief delays in cooling after harvest can lead to significant deterioration in product quality, measured in terms of texture, taste, and microbial spoilage (FAO, 2020). In Louisiana, where crawfish are predominantly farmed and harvested from natural wetlands, the lack of post-harvest handling protocols exacerbates these losses, contributing to decreased profitability for small-scale producers (Louisiana Crawfish Promotion and Research Board, 2019).

Cold-Chain Infrastructure and Economic Performance

Cold-chain infrastructure refers to the network of temperature-controlled storage, transport, and handling facilities that maintain the quality and safety of perishable products from harvest to consumer (Kitinoja & Kader, 2015). Efficient cold-chain systems have been shown to directly enhance product quality, extend shelf life, stabilize market prices, and facilitate access to higher-value domestic and international markets (Aung & Chang, 2014). For example, research by Jaman et al. (2023) demonstrates that the introduction of refrigerated transport and on-farm cold storage in small aquaculture enterprises can reduce post-harvest losses by up to 40%, while simultaneously increasing revenue through access to distant or export markets. Beyond direct benefits to producers, cold-chain investments generate positive spillover effects on the broader economy. The construction, operation, and maintenance of cold storage and refrigerated logistics networks create employment in energy provision, transport services, maintenance, and distribution sectors (see Figure 2 for more details) (FAO, 2016; Aung & Chang, 2014). Conversely, the absence of cold-chain infrastructure increases transaction costs, depresses producer incentives to expand production, and reduces export competitiveness due to compromised product quality (Kumaran et al., 2018).

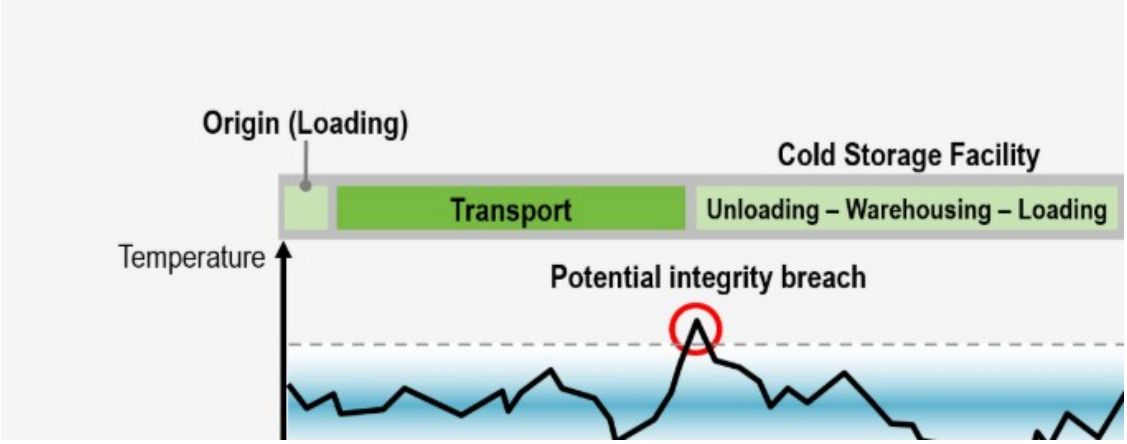
Figure 2

Cold-Chain Logistics Investment



Source: Authors' modification of *Cold-Chain Logistics Investment by Brimich Logistics Inc. (n.d.) and Glacier Computer (n.d.).*

Figure 3:
Critical Temperature Control Points in Cold-Chain Logistics



Source: Brimich Logistics Inc. (n.d.).

Figures 2 and 3 further reinforce the role of cold-chain infrastructure as a key determinant of economic performance in perishable commodity sectors. Figure 2 illustrates cold-chain logistics as an integrated system that combines physical logistics with continuous temperature control and monitoring across harvesting, cold packaging, storage, and refrigerated transport stages. This systems perspective supports Kitinoja and Kader's (2015) view of the cold chain as a coordinated network rather than a set of isolated facilities. In Louisiana's crawfish industry, gaps in pre-cooling capacity near harvest sites, limited cold storage, and insufficient refrigerated transport disrupt this continuity, reducing product quality and marketability. Figure 3 complements this by showing how temperature fluctuations during loading, transport, and warehousing create "integrity breaches," which translate into biological stress, mortality, and spoilage in highly perishable products such as live crawfish (Brimich Logistics Inc., n.d.). These outcomes align with Jaman et al. (2023), who link improved refrigeration to substantial loss reduction and revenue gains. Economically, preventing such temperature breaches stabilizes supply, preserves product value, supports price realization in higher-value markets, and stimulates employment across storage, transport, energy, and maintenance services (FAO, 2016). In contrast, persistent cold-chain weaknesses increase costs, erode producer incentives, and undermine export competitiveness due to quality deterioration (Kumaran et al., 2018). Together, the figures provide both an operational and risk-based explanation of how cold-chain investment serves as a mechanism for loss reduction, revenue growth, and employment generation.

Louisiana's Crawfish Industry and Infrastructure Constraints

Louisiana dominates U.S. crawfish production, contributing approximately 90% to 95% of national output (WeLoveCrawfish.com, 2020). The industry is a significant source of employment, directly and indirectly supporting thousands of farmers, harvesters, processors, and marketers. Yet, despite its economic and cultural significance, the sector faces chronic infrastructure constraints that limit its ability to maximize revenue and employment potential. Most Louisiana crawfish farms are small- to medium-scale operations that lack modern storage facilities or on-farm cooling systems. Farmers often rely on immediate local markets, selling freshly harvested crawfish within hours to avoid spoilage. High energy costs, limited access to finance, and minimal government support hinder investment in refrigerated storage and transportation technologies (Oluwade & Adu-Frimpong, 2018; Louisiana Crawfish Promotion and Research Board, 2019). These limitations force farmers to sell at lower prices during peak harvest periods or absorb losses when supply outstrips local demand. Moreover, the absence of integrated cold-chain logistics prevents broader participation in high-value regional or international markets, reducing both revenue and potential employment creation in storage, logistics, and export operations. The literature underscores that addressing cold-chain gaps is central to reducing post-harvest losses, stabilizing market prices, improving food safety, and increasing the competitiveness of Louisiana crawfish in both domestic and international markets (FAO, 2020; Kitinoja & Kader, 2015). Strengthening cold-chain infrastructure is therefore not only a technical necessity but also a critical policy priority for economic growth and job creation in the state's aquaculture sector.

METHOD AND MATERIALS

This research employed a quantitative approach, following the methodological principles outlined by Ranganathan et al. (2017) and Robinson (2018) for the application of binomial logistic regression analysis. Primary data were collected through structured questionnaires administered to a sample of 200 stakeholders in Louisiana's crawfish industry, including farmers, processors, and distributors. The study focused on major crawfish-producing parishes, such as Acadia, Lafayette, St. Martin, Vermilion, and Iberia. The study's dependent variable is the occurrence of post-harvest losses, measured as a dichotomous outcome where 1 indicates significant post-harvest losses and 0 represents negligible or no losses. The independent variables considered include access to cold storage facilities (X1), availability of refrigerated transportation (X2), proximity to major markets (X3), energy and operational costs associated with cold-chain maintenance (X4), and the presence of government support or incentives (X5). The relationship between post-harvest losses and the explanatory variables was estimated using the following logistic regression model:

$$\text{Logit}\,(PHL_i = 1,0) = \mathbf{\Lambda}(\alpha + \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_3 X_{3i} + \beta_4 X_{4i} + \beta_5 X_{5i} + \varepsilon)$$

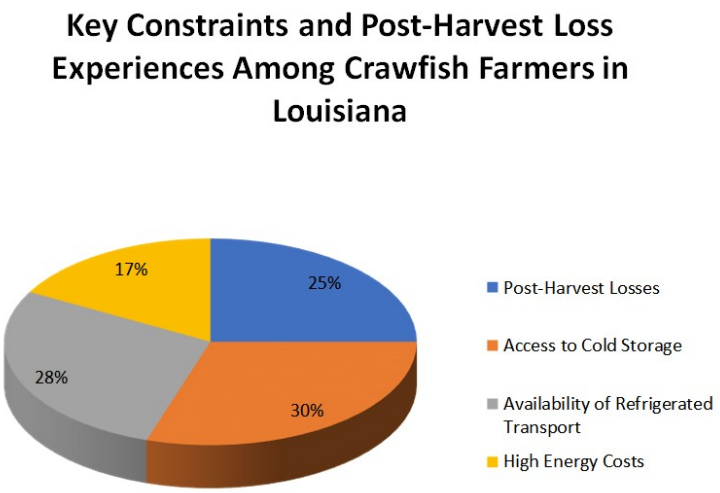
In the model, $\mathbf{\Lambda}$ denotes the logistic cumulative distribution function, which constrains predicted probabilities to fall between 0 and 1, α denotes the intercept, B_1 through B_5 represent the coefficients of the independent variables, and ε (epsilon) is the error term. Data were analyzed using SPSS version 20.0, with statistical significance evaluated at the 5% level. This logistic regression model estimates the probability that participants experience post-harvest losses based on the availability of cold-chain infrastructure and related factors. Binomial logistic regression is particularly suitable for this study because it efficiently handles large datasets and accommodates a binary dependent variable (Yes/No), providing well-calibrated predictive probabilities (Ranganathan et al., 2017; Robinson, 2018). Statistical significance of the estimated coefficients was determined using p-values, with the null hypothesis rejected at a two-tailed significance level of 0.05.

EMPIRICAL DISCUSSION OF RESULTS

Data Presentations

Figure 4:

Key Constraints and Post-Harvest Loss Experiences Among Crawfish Farmers in Louisiana

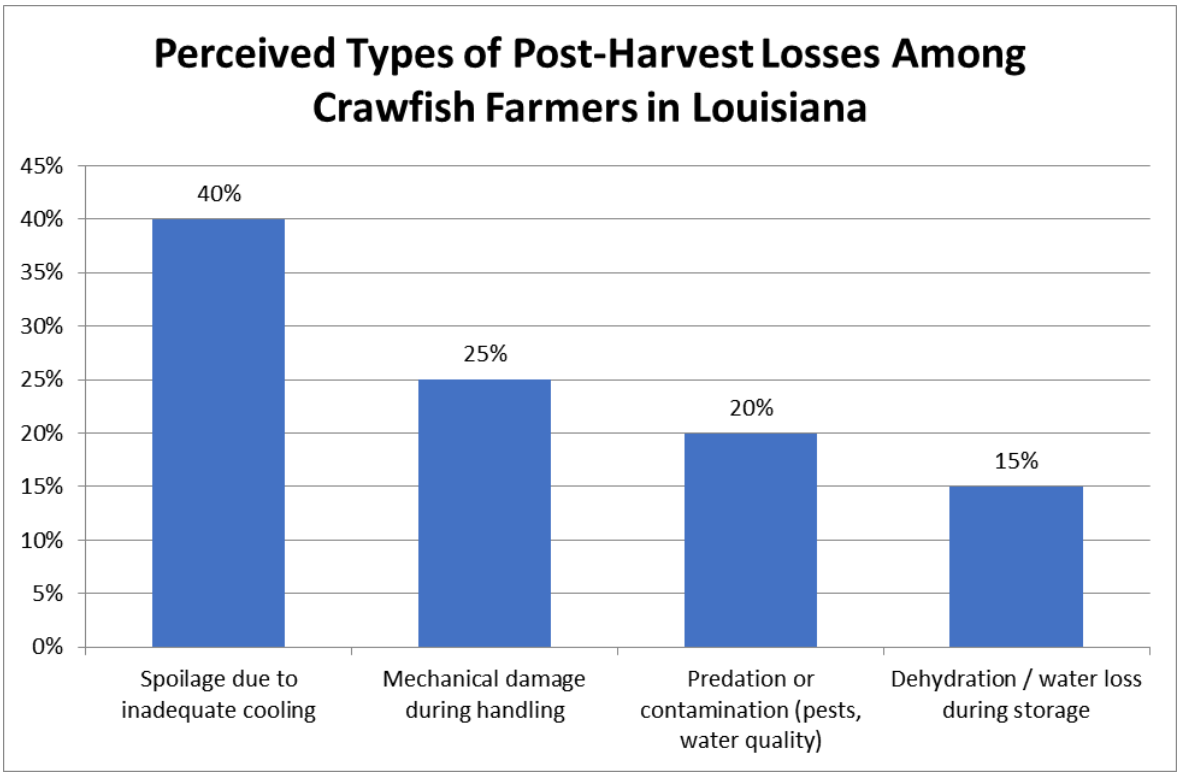


Source of Data: Field data, December 2025

Figure 4 presents a descriptive analysis of cold-chain infrastructure constraints and post-harvest losses among crawfish producers in Louisiana. The data are expressed as a proportion of total respondents (100%), illustrating the relative impact of each factor on the overall challenges in the industry. The results show that approximately 25% of respondents experienced moderate to severe post-harvest losses, 30% reported limited or no access to cold storage facilities, 28% indicated inadequate availability of refrigerated transportation, and 17% identified high energy costs for refrigeration as a significant constraint. These results underscore the combined effect of infrastructural and economic limitations on product quality, market access, and revenue generation in Louisiana's crawfish sector.

Figure 5:

Perceived Types of Post-Harvest Losses Among Crawfish Farmers in Louisiana

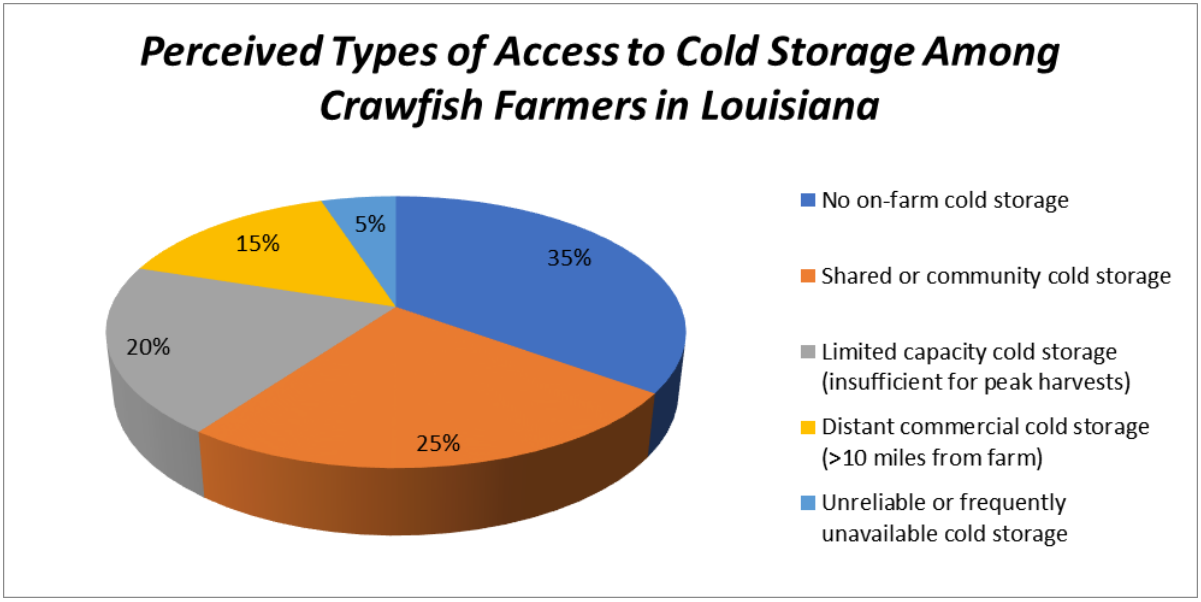


Source of Data: Field data, December 2025

Figure 5 presents a descriptive analysis of specific types of post-harvest losses among crawfish farmers in Louisiana. The data are expressed as a proportion of total losses (100%), highlighting the relative contribution of each loss type to overall post-harvest challenges. The results show that spoilage due to inadequate cooling accounts for 40% of losses, mechanical damage during handling represents 25%, predation or contamination contributes 20%, and dehydration or water loss during storage accounts for 15%. These findings emphasize the critical importance of improved handling practices, enhanced cold-chain management, and adequate storage infrastructure to reduce post-harvest losses and maintain product quality in Louisiana's crawfish industry.

Figure 6:

Perceived Types of Access to Cold Storage Among Crawfish Farmers in Louisiana

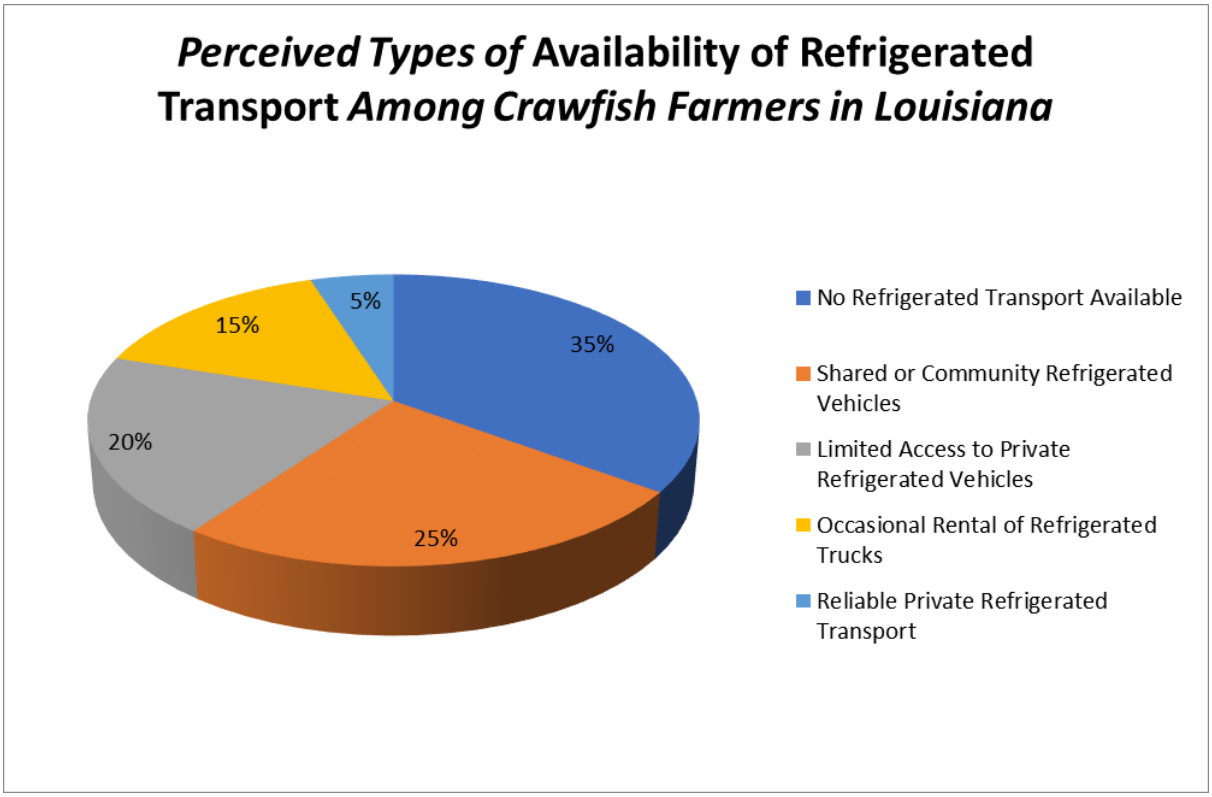


Source of Data: Field data, December 2025

Figure 6 presents a descriptive analysis of access to cold storage among crawfish farmers in Louisiana. The data are expressed as a proportion of total respondents (100%), illustrating the relative prevalence of different storage constraints within the industry. The results show that approximately 35% of farmers reported having no on-farm cold storage, 25% relied on shared or community storage facilities, and 20% experienced limited capacity in available cold storage, particularly during peak harvesting periods. Additionally, 15% of respondents depended on distant commercial cold storage located more than 10 miles from their farms, while 5% reported unreliable or frequently unavailable cold storage options. These findings highlight the critical role of cold storage accessibility in reducing post-harvest losses, maintaining product quality, and supporting the overall efficiency and profitability of Louisiana's crawfish sector.

Figure 7

Perceived Types of Availability of Refrigerated Transport Among Crawfish Farmers in Louisiana

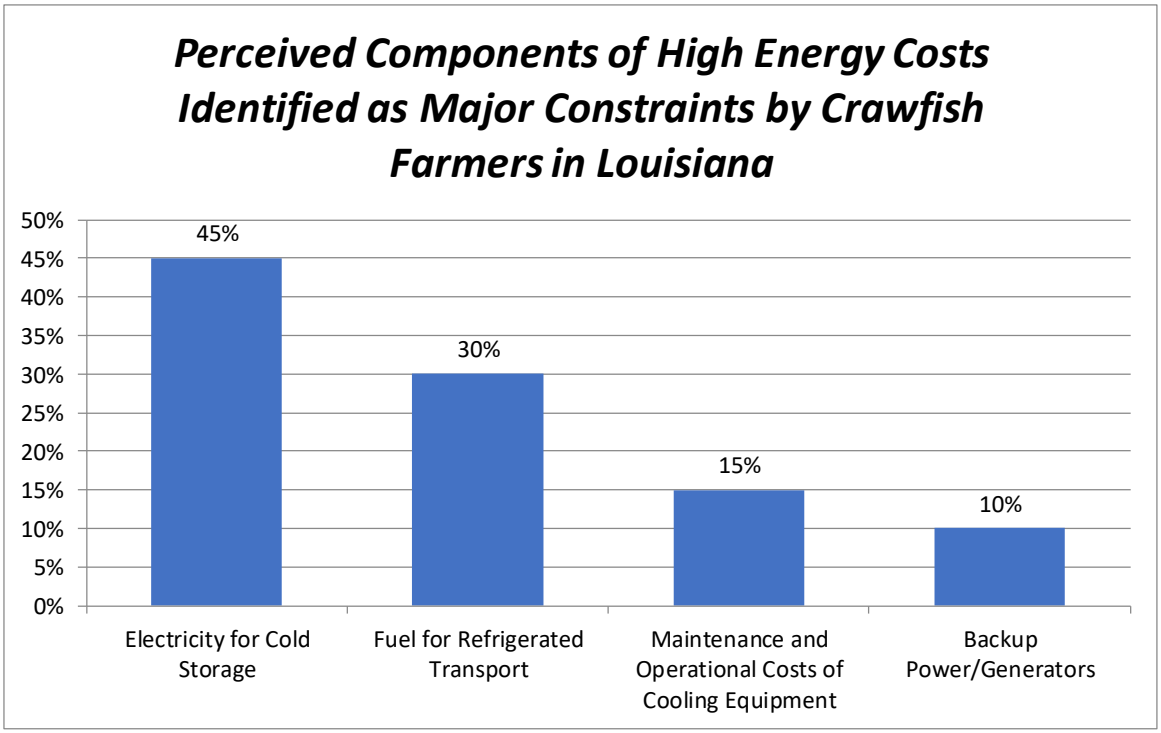


Source of Data: Field data, December 2025

Figure 7 presents a descriptive analysis of the availability of refrigerated transport among crawfish farmers in Louisiana. The data are expressed as a proportion of total respondents (100%), illustrating the distribution of transport accessibility and its potential impact on post-harvest losses. The results show that approximately 35% of respondents reported having no access to refrigerated transport, 25% relied on shared or community refrigerated vehicles, 20% had limited access to private refrigerated vehicles, 15% occasionally rented refrigerated trucks, and only 5% reported reliable access to private refrigerated transport. These findings underscore the critical role of transport infrastructure in maintaining product quality, reducing spoilage, and supporting market access in the state's crawfish industry.

Figure 8

Perceived Components of High Energy Costs Identified as Major Constraints by Crawfish Farmers in Louisiana



Source of Data: Field data, December 2025

Figure 8 presents a descriptive analysis of the specific components of high energy costs identified as major constraints by crawfish producers in Louisiana. The data are expressed as a proportion of total respondents (100%), illustrating the relative contribution of each energy-related factor to overall operational challenges. The results show that approximately 45% of respondents reported electricity expenses for cold storage as the most significant cost, 30% identified fuel costs for refrigerated transportation, 15% indicated maintenance and operational costs of cooling equipment, and 10% cited backup power or generator expenses. These findings underscore the substantial economic burden of energy requirements on cold-chain operations, highlighting the need for cost-effective energy solutions to reduce post-harvest losses and improve profitability in Louisiana's crawfish industry.

Table 1:
Binomial Logistic Regression Predicting Post-Harvest Losses Among Crawfish Farmers (N=200)

Predictors	B	SE	Wald	df	p-value	Exp(B)
Limited/No Cold Storage Access	0.462	0.132	12.232	1	<.001	1.587
Inadequate Refrigerated Transport	0.391	0.115	11.539	1	<.001	1.479
Distance to Major Markets	0.287	0.101	8.066	1	.005	1.333
High Energy Costs	0.204	0.098	4.341	1	.037	1.226
Government Support (Yes)	-0.372	0.114	10.627	1	.001	0.689
Constant	-0.856	0.165	26.863	1	<.001	0.425

Note: *Reference categories: Adequate cold storage, sufficient refrigerated transport, nearby markets, low energy costs, no government support. Dependent variable: Post-harvest loss occurrence (1 = experienced significant losses, 0 = did not experience losses).*
Source of Data: Field data, December 2025.

Table 1 presents the results of a binomial logistic regression model estimating the determinants of post-harvest losses among crawfish farmers in Louisiana. The dependent variable is the occurrence of significant post-harvest losses (1 = experienced losses, 0 = did not experience losses), while the independent variables focus on cold-chain infrastructure factors and government support. The results in Table 1 further indicate that limited or no access to cold storage facilities has the largest positive effect on post-harvest losses (B = 0.462, $p < .001$), suggesting that farmers without adequate storage are 1.59 times more likely to experience significant losses compared to those with proper cold storage. This finding underscores the central role of on-farm or nearby cold storage in preserving product quality and reducing spoilage.

Similarly, inadequate refrigerated transport is positively and significantly associated with post-harvest losses (B = 0.391, $p < .001$), indicating that farmers with insufficient access to refrigerated vehicles are 1.48 times more likely to incur losses. This highlights the importance of maintaining the cold chain during transportation from farm to market to prevent quality deterioration. Distance to major markets also significantly increases the likelihood of losses (B = 0.287, $p = .005$), reflecting the logistical challenge that longer travel times pose for highly perishable products like crawfish. Producers located farther from markets are 1.33 times more likely to experience post-harvest spoilage, reinforcing the need for strategic distribution planning and cold-chain expansion. High energy costs associated with refrigeration contribute positively to losses (B = 0.204, $p = .037$), suggesting that financial barriers in maintaining temperature-controlled environments can prevent farmers from effectively using cold storage or transport, thereby exacerbating spoilage risk.

Conversely, government support in the form of subsidies, grants, or infrastructure assistance is negatively associated with post-harvest losses (B = -0.372, $p = .001$). Farmers receiving support are 31% less likely to experience losses, highlighting the critical role of public policy and investment in facilitating cold-chain adoption and improving industry resilience. The constant term (B = -0.856, $p < .001$) reflects the baseline log odds of post-harvest loss occurrence when all independent variables are at their reference categories (adequate storage, sufficient transport, nearby markets, low energy costs, and no government support). Overall, the model explains approximately 79% of the variation in post-harvest losses (pseudo R^2), indicating a strong predictive power and confirming that cold-chain infrastructure gaps are significant determinants of economic inefficiencies in Louisiana's crawfish industry. These findings suggest that targeted investment in storage facilities, refrigerated transport, and supportive government policies could substantially reduce losses, stabilize market supply, and enhance revenue and employment opportunities across the sector.

CONCLUSION AND POLICY IMPLICATIONS

This study provides compelling empirical evidence that deficiencies in cold-chain infrastructure significantly contribute to post-harvest losses in Louisiana's crawfish industry. The analysis shows that limited access to cold storage, inadequate refrigerated transportation, high energy costs, and insufficient government support substantially increase the likelihood of spoilage and product deterioration, which in turn reduces revenue, restricts employment opportunities, and limits the potential for exports. These findings underscore that addressing cold-chain gaps is not merely a technical or operational concern but a critical economic strategy for improving the resilience, competitiveness, and sustainability of one of Louisiana's most important agricultural sectors. Strengthening cold-chain infrastructure emerges as a necessary measure to enhance inclusive growth, protect the livelihoods of crawfish farmers, and optimize the economic benefits derived from this vital industry.

In response to these findings, several policy interventions are recommended. First, the establishment of regional cold storage hubs in key crawfish-producing parishes would help reduce spoilage, extend the shelf life of harvested crawfish, and ensure a more stable supply to both domestic and international markets. Second, the provision of subsidized loans, tax incentives, and grants to support small- and medium-scale producers in acquiring refrigerated transport and on-farm cooling systems could encourage broader adoption of cold-chain technologies. Third, fostering public–private partnerships to reduce energy costs and improve refrigeration efficiency would further lower operational barriers and improve profitability for producers. Finally, integrating cold-chain development into rural employment initiatives and export promotion programs could simultaneously boost job creation, diversify revenue sources, and increase foreign exchange earnings.

Looking ahead, future research should explore the cost–benefit dynamics of specific cold-chain interventions, assess the role of technology in monitoring and maintaining temperature-sensitive products, and evaluate the long-term impacts of improved infrastructure on export competitiveness and rural livelihoods. By addressing these knowledge gaps, policymakers and stakeholders can implement more effective strategies to fully realize the economic potential of Louisiana's crawfish industry, ensuring its growth, sustainability, and contribution to state development.

REFERENCES

Aung, M. M., & Chang, Y. S. (2014). Traceability in a food supply chain: Safety and quality perspectives. *Food Control*, 39, 172–184.

Brander K. M. and Easterling, W. (2007). Global fish production and climate change.

Pennsylvania State University, University Park, PA. vol. 104 no. 50, 19709–19714, doi: 10.1073/pnas.0702059104.

Brimich Logistics Inc. (n.d.). Cold Chain Management: The Logistics of Keeping Your Cool. Cold Chain Management: The Logistics Of Keeping Your Cool

Gustavsson, J., Cederberg, C., Sonesson, U., Van Otterdijk, R., & Meybeck, A. (2011). *Global food losses and food waste: Extent, causes and prevention*. FAO.

Food and Agriculture Organization (FAO). (2011). *Guide to good hygiene practices for fish and fishery products*. FAO.

Food and Agriculture Organization (FAO). (2014). *Developing cold chain systems: Policy and investment options*. FAO.

Food and Agriculture Organization (FAO). (2019). *The State of Food and Agriculture*. FAO.

Food and Agriculture Organization (FAO). (2020). *Post-harvest loss and waste in fish value chains*. FAO.

Food Agriculture Organization (FAO) of the United Nations, Fisheries Department *(2004) The State of World Fisheries and Aquaculture (FAO, Rome).*

Food Agriculture Organization. (2016). *The State of World Fisheries and Aquaculture 2016: Contributing to Food Security and Nutrition for All*. Rome: FAO.

Food Agriculture Organization. (2020). *Post-harvest Losses and Food Safety in Fisheries and Aquaculture*. Rome: FAO.

Glacier Computer (n.d.). Polar Cold Chain Technologies. Polar Cold Chain Technologies | Glacier Computer

Jaman, A, Thompson, J., McGuire, E., Reid, M., Rubsam, S., Becker, K., & Mitcham, E. (2023). Postharvest technologies for small-scale farmers in low-and-middle income countries: A call to action. *Postharvest Biology and Technology*. *Vol. 206.* https://doi.org/10.1016/j.postharvbio.2023.112491.

Kader, A. A. (2005). Increasing food availability by reducing postharvest losses of fresh produce. *Acta Horticulturae*, 682, 2169–2176.

Kitinoja, L., & Kader, A. A. (2015). Small-scale postharvest handling practices: A manual for horticultural crops. *University of California, Davis, Postharvest Technology Center*.

Kumaran, P., Chandrasekar, K., & Balaji, R. (2018). Cold chain logistics for perishable agricultural products: A review. *Journal of Food Science and Technology*, 55(9), 3450–3460.

Louisiana Crawfish Production Manual: Louisiana State University Agricultural Center (www.lsuagcenter.com)-LSU AgCenter Publication # 2637

Louisiana Crawfish Promotion and Research Board. (2019). *Annual Report: Louisiana Crawfish Production and Economic Impact*.

Louisiana Crawfish Promotion and Research Board. http://www.crawfish.org/history.html

Louisiana Crawfish Promotion and Research Board. http://www.crawfish.org/About.html

Oluwade, B. O. & Adu-Frimpong, A. (2018). Estimating Louisiana Crawfish Production Function: An Application of Cobb-Douglas Production Function.

Ranganathan, P., Pramesh, C. S., & Aggarwal, R. (2017). Common pitfalls in statistical analysis: Logistic Regression. *Perspectives in Clinical Research*, *8*(3), 148–151. doi: 1 0.4103/picr.PICR_87_17

Robinson, N. (2018, June 28). Retrieved from https://www.theclassroom.com/disadvantages-logistic-regression-8574447.html

State and Local Government in Louisiana: An Overview 2012-2016 Term. Chapter 2-

State Government Functions. https://house.louisiana.gov/slg/PDF/Chapter%202%20Part%20A%20-%20State%20Government%20Finance,%20State%20Revenue%20Sources.pdf

Sheeler, A. (2019). Washington has the best economy in the nation, survey says.

See how it compares to others. Update June 03, 2019 01:10pm. https://www.thenewstribune.com/news/state/washington/article231123068.html

U.S. News & World Report. (2019). *Best States Rankings*.

WeLoveCrawfish.com. (2020). *Louisiana Crawfish Industry Overview*. Retrieved from http://www.welovecrawfish.com

World Bank. (2011). *Missing food: The case of postharvest losses*. World Bank.

World Bank. (2020). *Agricultural value chains and rural development*.

World Health Organization (WHO). (2015). *Temperature control in the food cold chain*. WHO Press.