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Ice Valuation among Artisanal Fishers in Hadramawt

Findings from a Field-based Choice Study

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Key Findings

A field-based choice study of 129 artisanal fishers in two coastal locations in Hadramawt, Yemen, supports the following key findings:

- **Ice use for chilling fish is very low, despite willingness to adopt its use.** Only 2 percent of fishers reported always using ice, yet 53 percent of fishers indicated willingness to adopt ice use and 36 percent were willing to forgo a cash payment in exchange for a bag of ice. This gap is consistent with low adoption being driven primarily by economic constraints rather than lack of awareness.
- **Fishers' valuation of ice is well below its market prices.** The average valuation is approximately 2,200 YER per bag of ice, less than half the prevailing market price of 5,000–6,000 YER. Only about 3 percent of fishers would choose to purchase ice at current prices.
- **Willingness to adopt ice is highly price-sensitive.** The share of fishers willing to adopt ice rises sharply as prices decline. A reduction to around 2,500 YER per bag—approximately half the current market price—could increase adoption to an estimated 40–50 percent of fishers.
- **Expected gains from ice use vary by species.** Price premiums are modest for the most commonly targeted fish species, limiting the economic incentive for most fishers to use ice.
- **Access to iceboxes is associated with higher willingness to adopt ice use.** Fishers who own an icebox are about 20 percentage points more likely to indicate willingness to adopt ice use and are willing to forgo approximately 1,390 YER more to obtain ice. This highlights the importance of complementary assets, such as iceboxes, in shaping adoption decisions.

Artisanal fisheries are central to livelihoods along the Gulf of Aden coast, where most fishers operate small boats on short, same-day fishing trips. Catches are typically sold within hours of landing at local fresh fish markets, which have limited or no cold storage. In this setting, maintaining fish quality between

capture and sale—especially during warmer months or periods of high temperatures—is important for preserving freshness and potentially accessing buyers willing to pay higher prices for higher-quality fish.

Ice is the primary means of chilling fish on these boats. Fishers typically purchase large blocks or bags of ice, crush them, and store them with the catch in insulated boxes (iceboxes) on board. Unlike larger-scale fisheries in more developed settings, these boats are not equipped with onboard cooling systems such as ice machines or refrigerated storage. As a result, ice can play an important role in preserving quality and potentially improving sale prices in fresh fish markets (Belton and Bahurmiz 2026a).

Despite these potential benefits, the use of ice remains limited among fishers (Belton and Bahurmiz 2026a; Belton et al. 2026b). This is notable given the potential for quality deterioration, particularly on longer trips or during warmer months. However, using ice involves costs beyond its purchase price, including time and effort required to obtain it, limited availability at certain times, and trade-offs in onboard space and weight. In addition, high ice production costs, driven by unreliable electricity supply and reliance on diesel generators, as well as limited investment in modern ice-making equipment, translate into high market prices for ice (Belton et al. 2026b). These higher costs are passed on to fishers. Beyond the cost of ice, forgoing its use also carries a risk of quality deterioration and associated losses. However, for small boats making short, same-day trips, physical and economic losses without ice appear in practice to be limited (Belton and Bahurmiz 2026a).

Thus, low adoption of ice may reflect rational decision-making under uncertainty. Fishers may not be convinced that the price premium for higher-quality fish consistently outweighs the cost of ice. Uncertainty about daily catch volumes, variability in market access, and liquidity constraints can further discourage taking on additional upfront costs. In this context, limited use of ice may reflect not only supply constraints, but also insufficient expected economic gains at prevailing prices.

This project note discusses a field-based choice exercise used to elicit fishers' willingness to trade off cash for ice. By identifying the price point at which fishers are willing to forgo cash for ice, the analysis provides insight into whether lowering ice prices would meaningfully increase uptake.

Study setting and approach

The study was conducted in two coastal locations in Hadramawt, Mukalla and Qusayir, which differ in infrastructure, market access, and the cost of obtaining ice. Mukalla is a larger urban port city where ice is typically available near landing sites, while Qusayir is a more rural fishing community where fishers often face higher prices and additional effort to obtain and transport ice. The field exercise took place in January 2026, during the peak fishing season (October–April), when fishing activity is high and daily trips are common.

The study included a total sample of 129 artisanal fishers, comprising 65 fishers from Mukalla and 64 fishers from Qusayir. Participants were selected based on three criteria: (i) they primarily target commonly traded species in Hadramawt's artisanal fisheries, including kawakawa and striped bonito (Belton and Bahurmiz 2026a; Belton et al. 2026b); (ii) they operate small- to medium-size fishing boats typical of short, same-day fishing trips (generally less than 10 meters in length); and (iii) they reported that they intended to go fishing the following day. Together, these criteria were designed to ensure that the sample reflects common fishing practices and market conditions, while also tying choices made in the exercise to actual fishing activity on the following day. Surveys were conducted in the evening at or near landing sites, when fishers had returned from their daily trip and were preparing for their next trip.

Each participant first completed a short survey on fishing practices, assets, and operational characteristics. This was followed by a structured choice exercise used to elicit their valuation of a bag of ice, defined as the maximum cash amount they were willing to forgo in exchange for receiving one bag of ice. Participants made 13 binary decisions between receiving one bag of ice or a cash amount ranging from 0 to 6,000 Yemeni rials (YER)[1] in increments of 500 YER (see Box 1 for details on local ice-pricing conditions). For each decision, fishers indicated whether they preferred the listed cash amount or one bag of ice. The point at which a fisher switched from preferring ice to preferring cash was recorded as their switching point, representing the highest value they placed on one bag of ice. Then, one of each participant's 13 decisions was randomly selected and implemented, meaning that they received either the specified cash amount *or* a bag of ice corresponding to that decision. Fishers who chose ice in the randomly selected decision received it ahead of their next trip—either at the landing site just before departure or via a coupon redeemed at the on-site ice factory at their convenience—meaning that decisions were to be implemented under real fishing conditions rather than hypothetical responses.

Box 1: Ice Pricing Context

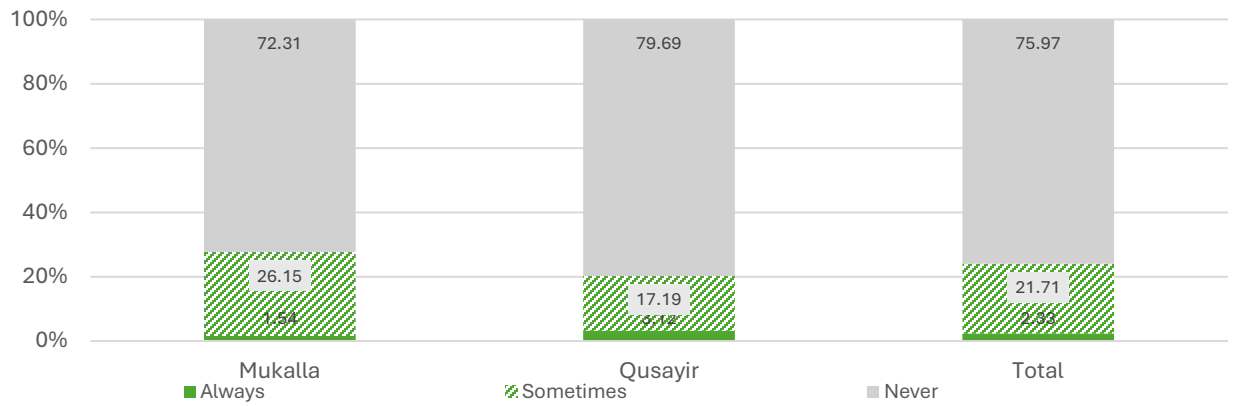
Ice bags used in the choice exercise weighed between 40 and 50 kg, with prices varying by location. In Mukalla, one bag of ice was sold at 5,000 YER with no delivery cost, as ice production facilities are located near landing sites. In Qusayir, prices ranged from 5,000 to 6,000 YER, with additional delivery costs of around 1,000 YER per bag (for a total price of 6,000 to 7,000 YER). These prevailing market prices provide a benchmark for interpreting study results.

Results

Low use despite willingness to adopt ice

Reported use of ice is extremely limited. Based on survey responses, only about 2 percent of fishers always use ice on their fishing trips, and roughly three-quarters never use it (Figure 1).

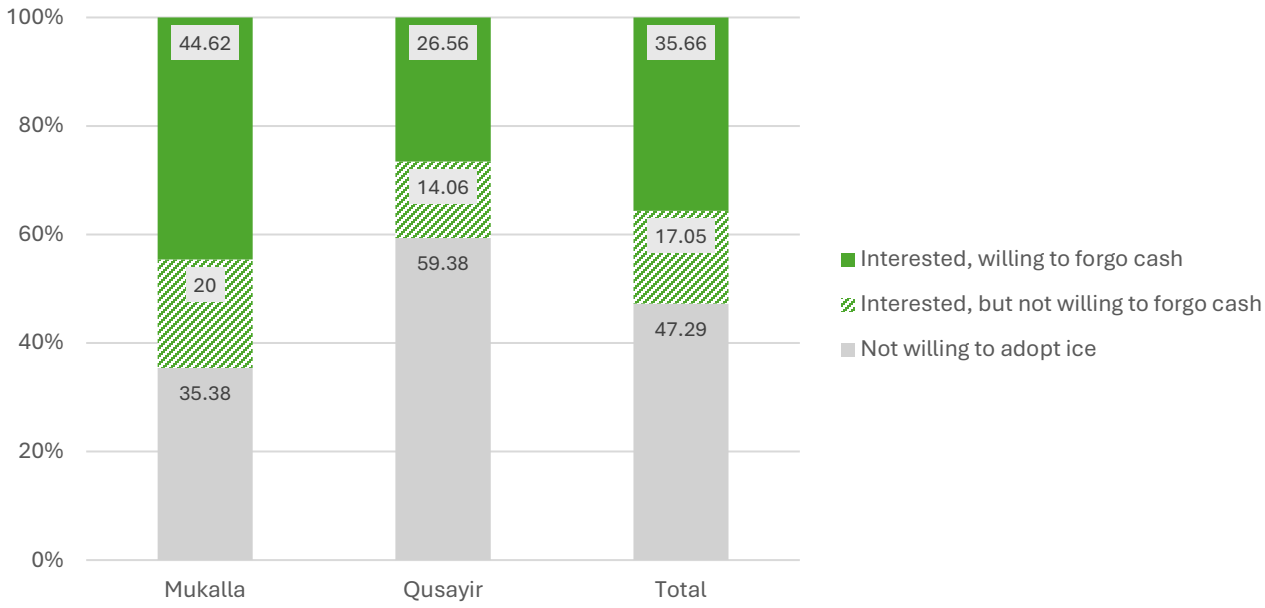
Figure 1: Use of ice on fishing trips



[1] All prices are expressed in Yemeni rials (YER) at January 2026 price levels. At the time of data collection, the exchange rate was approximately 1,600 YER per US dollar.

In contrast, results from the choice exercise indicate substantially higher willingness to adopt ice (Figure 2). While 47 percent of fishers were not willing to adopt ice, as indicated by consistently choosing cash over ice at all price points, the remaining 53 percent indicated some level of willingness to adopt ice. Among them, 17 percent preferred ice when the alternative cash amount was zero but were unwilling to forgo cash to obtain it, while 36 percent were willing to give up a positive cash amount in exchange for a bag of ice.

Figure 2: Willingness to adopt ice use, as indicated in the choice exercise



Willingness to adopt ice was higher among fishers in Mukalla than in Qusayir. In Mukalla, 65 percent of fishers indicated willingness to adopt ice, compared to 41 percent in Qusayir, and a larger share were willing to forgo cash to obtain ice. These differences may reflect variation in market conditions, including differences in marketing channels, buyer preferences for fish quality, and the time between landing and sale, in addition to differences in the cost of accessing ice.

Taken together, these findings point to a gap between reported use from the questionnaire and stated valuation from the ice valuation exercise. While most fishers do not use ice in practice, a substantial share indicate willingness to adopt ice use when faced with explicit trade-offs. This suggests that low adoption is unlikely to be driven by lack of awareness alone. Instead, it appears more consistent with rational economic decision-making, as fishers weigh the cost of ice against the expected—but often uncertain—returns.

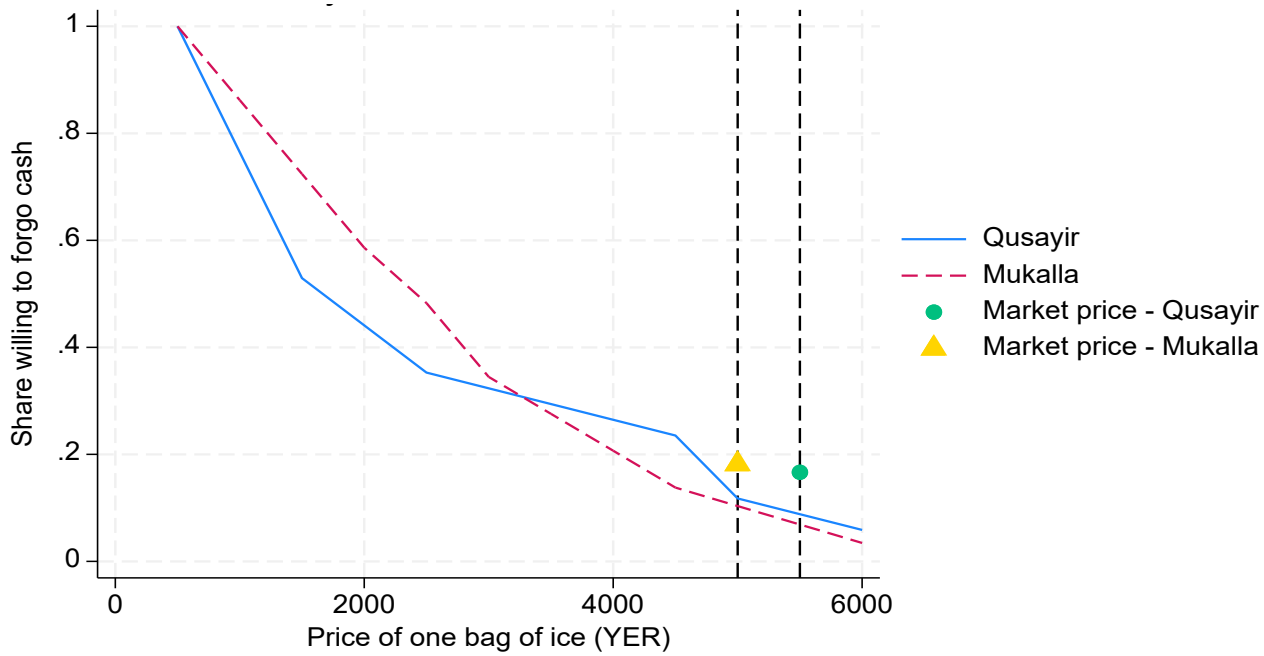
Valuation of ice

Despite the observed willingness to adopt ice, relatively few fishers value it at prevailing market prices. Across both locations, only about 3 percent of fishers' valuations of ice match current market rates. The average valuation was approximately 2,200 YER—less than half (37–44 percent) of the prevailing market price of 5,000–6,000 YER.

However, valuation is highly price-sensitive. As shown in Figure 3, the share of fishers willing to adopt ice use increases sharply at lower price points, suggesting that even moderate reductions in ice prices

could increase uptake, while adoption remains limited at current price levels. This underscores that low current usage coexists with potential for greater uptake if ice prices decline.

Figure 3: Valuation of ice by price and location

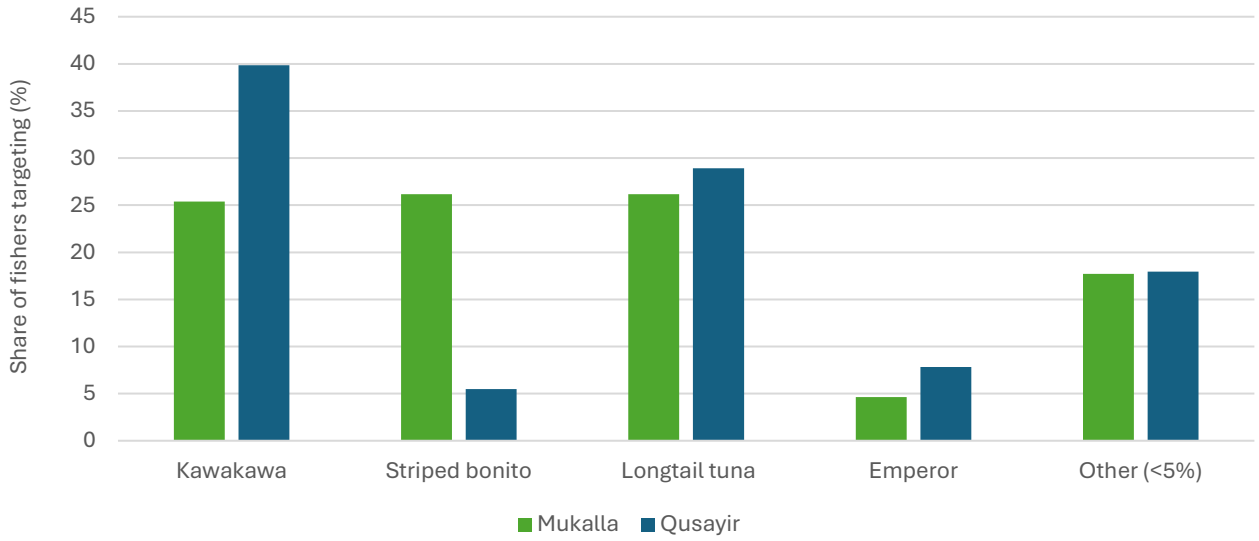


Differences across locations are consistent with variation in the total cost of accessing ice. In Mukalla, market prices are slightly lower, and fishers do not incur delivery costs, as ice is available directly at landing sites. In contrast, fishers in Qusayir often face both slightly higher prices and additional delivery costs that further increase the total cost of ice. This helps explain the smaller share of Qusayir fishers valuing ice at prevailing prices. However, the overall similarity in valuation patterns across locations suggests that the price of ice remains an important constraint in both settings.

Price premiums from ice vary by fish species

Although the sample was designed to reflect commonly targeted species, particularly kawakawa and striped bonito, there remains variation in species targeted across fishers and trips. As shown in Figure 4, most fishers in the sample target a relatively small set of species, with a clear dominance of kawakawa and striped bonito. In Qusayir, these two species together account for about 45 percent of reported primary target species, while in Mukalla they account for almost 52 percent. Longtail tuna represents a substantial additional share, at 29 percent in Qusayir and 26 percent in Mukalla. Species vary considerably in the prices they command in local markets: emperor and striped bonito are among the higher-valued species, while kawakawa and longtail tuna—the most commonly targeted—tend to fetch lower prices. As shown below, this distinction matters for fishers' economic returns from using ice.

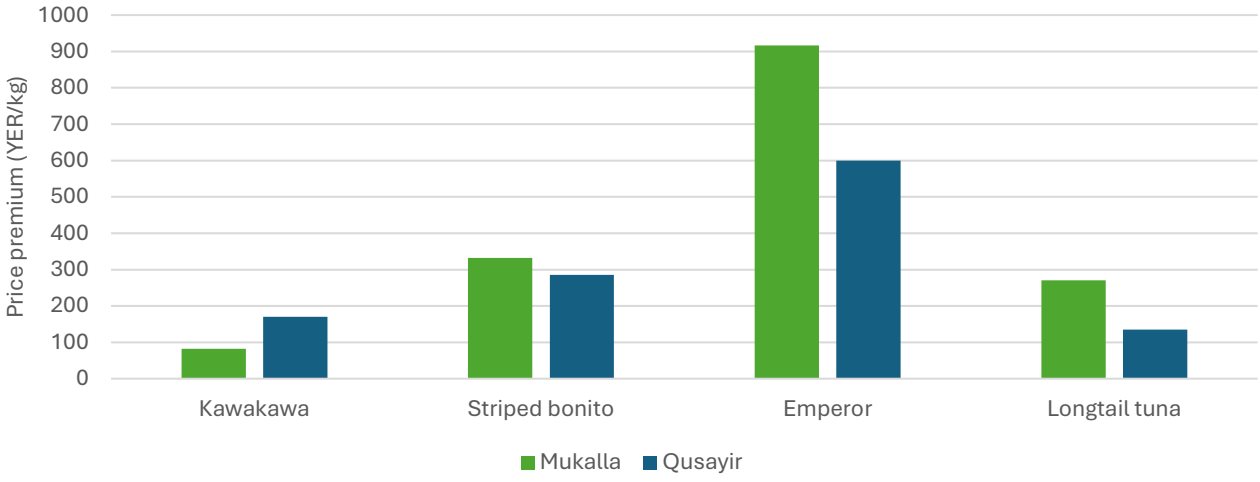
Figure 4: Primary target fish species for fishers



The price premiums fishers expect with ice use differ markedly across species. Fishers were asked to report the price they would expect to receive per kilogram for the same catch under two scenarios, with ice and without ice. In this study, price premiums are defined as the difference in average selling price per kilogram between catches stored with ice and comparable catches not stored with ice, within the same species and fishing conditions.[2]

As illustrated in Figure 5, perceived price premiums are relatively modest for the most commonly targeted species. Kawakawa yields an average premium of about 171 YER per kg (6 percent) in Qusayir and 82 YER per kg (2 percent) in Mukalla, while longtail tuna generates premiums of 135 YER per kg (3 percent) and 271 YER per kg (8 percent), respectively. Striped bonito yields somewhat higher premiums, at around 286 YER per kg (12 percent) in Qusayir and 332 YER per kg (7 percent) in Mukalla.

Figure 5: Price premium from ice use by fish species



[2] Approximately 20 percent of the reported price premiums are negative, indicating lower expected selling prices for iced catches relative to non-iced catches. This may reflect a perception among some consumers that iced fish is less fresh than fish sold without ice, as documented in qualitative interviews with retailers in Hadramawt (Belton and Bahurmiz 2026a).

Table 1 compares average reported sale prices with the expected gains from using ice for each species. For the most commonly targeted species, these premiums are small relative to average sale prices. This reinforces earlier evidence that, for most fishers, the additional revenue from using ice is often insufficient to offset its cost under current market prices. In contrast, less commonly targeted species, such as emperor, show considerably larger premiums—around 600 YER per kg (14 percent) in Qusayir and 664 YER per kg (13 percent) in Mukalla. This variation across species implies that the gains from ice use depend on what fishers catch. Because most fishers primarily catch species associated with relatively modest premiums, the expected gains from ice use are generally limited.

To further contextualize these premiums, it is useful to consider the cost of ice per kilogram of fish. Applying a 1:1 ice-to-fish ratio—the standard for tropical conditions (FAO 1989)—and prevailing ice prices of 5,000–6,000 YER per 40 kg bag, the cost of icing 1 kg of fish is approximately 125–150 YER. For kawakawa, the most commonly caught species, this leaves a net return of only 21–46 YER per kg in Qusayir and a net loss in Mukalla, where the premium of 82 YER per kg falls below the ice cost threshold. Longtail tuna shows a similar pattern. In contrast, striped bonito and emperor yield net returns well above the ice cost in both locations, but these species account for a smaller share of typical catches. Taken together, this suggests that for most fishers, who predominantly catch kawakawa, the expected revenue gain from ice use is unlikely to cover the its upfront cost, particularly given the added uncertainty of variable catches.

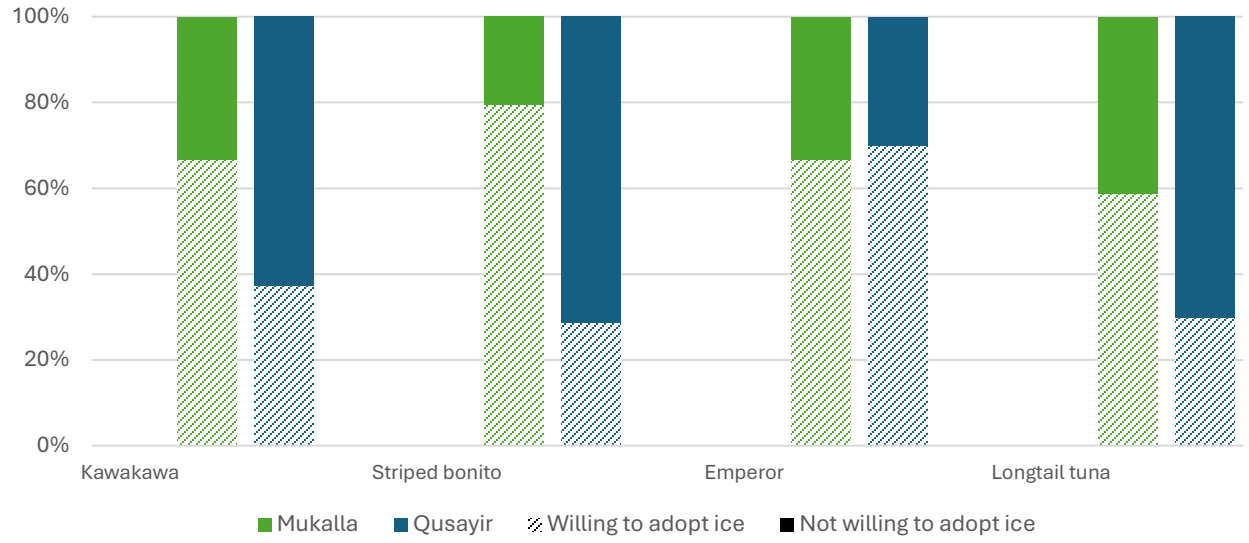
Table 1: Reported sale prices and price premiums

Fish species	Sale price (YER/kg)	Price premium for using ice (YER/kg)
Kawakawa		
Qusayir	2,680 (730)	171 (738)
Mukalla	3,400 (873)	82 (1,110)
Striped bonito		
Qusayir	2,360 (690)	286 (636)
Mukalla	4,620 (1,050)	332 (913)
Longtail tuna		
Qusayir	4,010 (1,930)	135 (1,060)
Mukalla	3,210 (1,270)	271 (1,080)
Emperor		
Qusayir	4,300 (1,320)	600 (876)
Mukalla	5,250 (1,990)	664 (665)

Note: Values reported as mean, with standard deviation in parentheses.

Patterns of willingness to adopt ice use are broadly consistent with these differences in expected price premiums. As shown in Figure 6, fishers targeting species with higher potential gains, such as emperor, tend to show greater willingness to adopt ice use. In contrast, those targeting kawakawa or longtail tuna exhibit lower levels of willingness, particularly in Qusayir.

Figure 6: Willingness to adopt ice use by targeted fish species



Taken together, these findings suggest that fishers' valuation of ice is shaped by the expected profitability of its use, given that most fishers target species associated with relatively low and variable price premiums. Combined with uncertainty in catch volumes across trips, the expected gain from using ice is generally low relative to its cost, which helps explain the limited adoption observed despite moderate levels of willingness to adopt ice use.

Assets and expected returns shape willingness to adopt ice

Regression results further indicate that willingness to adopt ice and its valuation are each associated with location, expected gains, and ownership of complementary assets.

Results presented in Table 2 reflect that fishers in Mukalla are significantly more likely to indicate willingness to adopt ice use, with a 22 percentage point higher probability ($p<0.01$), and report a valuation approximately 472 YER higher than fishers in Qusayir ($p<0.1$). These differences may reflect underlying variation in market conditions and the costs of accessing and using ice across locations.

Expected returns also play a role. The estimated price premium from using ice is positively associated with ice valuation, suggesting that fishers who anticipate higher price premiums are willing to forgo more cash to obtain ice. Although the estimated premium is small in magnitude, it is statistically significant ($p<0.1$), indicating that even modest expected gains in output prices meaningfully shape fishers' valuation of ice. However, this relationship is not substantial for willingness to adopt ice use, indicating that while expected gains influence valuation, they are not a primary driver of adoption willingness.

Table 2: Determinants of willingness to adopt ice use and valuation of ice

Variables	Willing to adopt ice use (0: No; 1: Yes)	Cash value fisher willing to forgo for ice (YER)
Location (0: Qusayir; 1: Mukalla)	0.219***	471.5*
	(0.0603)	(278.2)
Price premium for using ice (1,000 YER/kg)	0.0189	0.264*
	(0.0301)	(0.142)
Icebox ownership (0: does not own; 1: owns)	0.196***	1,388***
	(0.0691)	(285.8)
Constant	0.362***	668.8***
	(0.0453)	(248.2)
Observations	258	136
R-squared	0.089	0.180

Note: Observations correspond to fisher–species pairs based on the two primary species reported by each fisher, which represent their main target species. Focusing on these species ensures that estimated price premiums reflect expected returns under typical fishing conditions. The second column (cash value) is estimated based on the subsample of fishers indicating willingness to adopt ice use (including zero valuations). Statistical significance of coefficient estimates: *** p<0.01, ** p<0.05, * p<0.1.

Ownership of iceboxes emerges as a key determinant of willingness to adopt ice use. About 26 percent of fishers in the sample reported owning an icebox. These fishers are about 20 percentage points more likely to indicate willingness to adopt ice ($p<0.01$) and are willing to forgo about 1,390 YER more for it ($p<0.01$), equivalent to 63 percent of the average valuation. This pattern highlights the importance of complementary assets: having the capacity to store ice appears to increase its perceived value. These findings are consistent with the rationale behind interventions that expand access to iceboxes, such as those supported by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) Strengthening Resilience and Participation at Local Level (SRPL) project (Becker 2025), and suggest that such investments may strengthen incentives to adopt ice use by enabling fishers to better realize its potential benefits.

Overall, the results suggest that both economic returns and enabling conditions matter. While higher expected price premiums increase fishers' valuation of ice, access to complementary assets plays an important role in determining whether fishers find that the expected benefits of ice use outweigh its costs.

Conclusions

This study provides evidence that low ice adoption among artisanal fishers in Hadramawt is attributable to a gap between the cost of ice and the economic returns fishers expect from using it. At prevailing market prices of 5,000–6,000 YER per bag of ice in Mukalla and up to 7,000 YER (including delivery) in Qusayir, only about 3 percent of fishers would choose to purchase ice. The average valuation of a bag of ice is approximately 2,200 YER, which is 37–44 percent of prevailing ice prices, indicating that most fishers do not expect the premium from icing their catch to offset the cost under current conditions. This is consistent with the observed price premiums being modest relative to ice costs. Low adoption thus appears to reflect rational decision-making rather than a lack of awareness or access alone.

However, the share of fishers willing to adopt ice use rises considerably as ice prices decline, suggesting that targeted interventions that reduce the cost of ice or raise the returns to quality could meaningfully increase uptake. Complementary assets also matter: fishers who own iceboxes are more likely to indicate willingness to adopt ice and willing to forgo cash to obtain it, underscoring that the ability to store and use ice increases its perceived value.

- **Lower ice production costs.** Ice prices in Hadramawt are high largely because production relies on diesel generators in the context of an unreliable public electricity supply. Restoring or improving access to the public electricity grid or supporting the adoption of solar-powered ice-making equipment could substantially reduce production costs and translate into lower ice prices for fishers. Based on the observed price sensitivity, a reduction to around 2,500 YER per bag (approximately half the current market price) could increase adoption to an estimated 40–50 percent of fishers. Investments in grid rehabilitation and solar-powered ice-making infrastructure—including hybrid solar systems at fishery landing sites—have shown promise in Yemen and the wider region as a pathway to sustainably reducing production costs and improving cold chain access for small-scale fishers.

- **Strengthen market incentives for quality.** For most fishers, the expected price premium from icing their catch is too small to justify the cost. This may reflect both the species commonly targeted and the limited differentiation of fresh fish by quality at landing site markets. Evidence from household consumption surveys in Hadramawt (Jovanovic et al. 2026) shows that inland consumers already pay considerably higher prices for fresh fish transported on ice—for example, kawakawa prices are nearly twice as high inland as on the coast—suggesting that demand-side willingness to pay for quality exists but does not consistently reach fishers. Strengthening this market signal could involve training fish traders and market intermediaries to grade and price fish by freshness, piloting quality-based pricing at landing sites, or linking fishers to buyers—such as inland retailers or food service operators—who consistently pay a premium for iced catch. Reducing ice costs would further support these efforts by making it more economically viable for traders to extend ice-based supply chains to lower-value species and more remote inland markets.

- **Support icebox ownership as a complementary investment.** Icebox ownership is a significant predictor of both willingness to adopt ice use and valuation of it. Fishers without iceboxes face a binding constraint: even if ice prices fell, they would have limited ability to use ice effectively. Programs that expand access to iceboxes can therefore strengthen the incentive to adopt ice use by enabling fishers to realize its potential benefits. Such investments tend to be most effective when combined with improvements in ice availability and affordability.

- **Account for heterogeneity across species and contexts**. Gains from ice use vary considerably across species and fishing conditions, and interventions should reflect this. Higher-valued species such as emperor and striped bonito are associated with larger price premiums from icing, making ice use more economically attractive for fishers targeting those species. By contrast, for fishers predominantly targeting low-premium species such as kawakawa and longtail tuna—which account for the majority of catches in both locations—price reductions alone may be insufficient to justify ice use. Location-specific factors also matter. For example, additional delivery costs in Qusayir affect the feasibility of using ice and should be considered in program design.

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