

# IMPROVING FISH PRESERVATION: COOLING SOLUTION FOR FISH SELLERS

## EXPERIMENT RESULTS

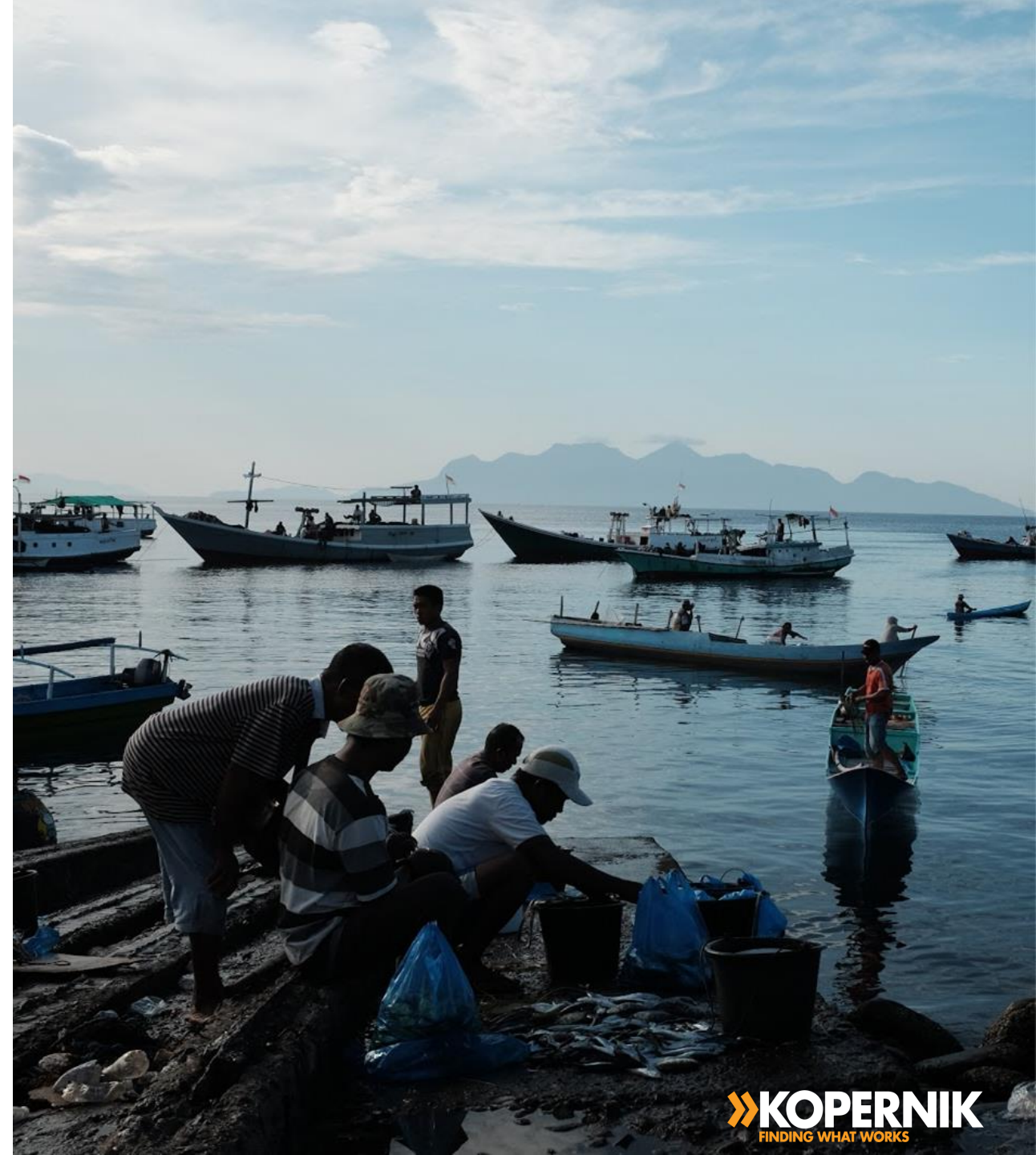
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# ABOUT MATA KAIL

The Creative Solutions for Sustainable Consumption and Production of Fish (MATA KAIL) Project, funded by the European Union, was implemented from **March 2018 until February 2021**. It focused on three regencies in East Nusa Tenggara; Lembata, Nagekeo and Sikka. The aim of the project was to **promote sustainable economic growth** and **employment opportunities** of marginalized youth, particularly young women, in the fish-processing sector in Indonesia.

Kopernik supported the implementation of the MATA KAIL project through technology testing interventions. The Cooling Solutions for Fish Sellers initiative is one of several experiments conducted to test solutions in improving efficiency in the fisheries sector as well as increasing the incomes of those working in the fish industry in East Nusa Tenggara.



# TABLE OF CONTENTS

- 1. Executive Summary 4
- 2. Fisheries Sector in Indonesia Overview 5
- 3. Project Overview 6
  - Context 7
  - Hypothesis 10
  - Experiment Design 11
  - Experiment Flow 12
- 4. Findings 13
  - Temperature 14
  - Fish Quality 15
  - Net income 16
  - Duration of Sales 17
- 5. Conclusion and Recommendation 18
- 6. Annex 22

# EXECUTIVE SUMMARY

As part of the [MATA KAIL project](#), Kopernik tested a cooling solution for mobile fish sellers delivering fish from the landing site to villages in Sikka regency, East Nusa Tenggara province (NTT). This cooling solution was introduced as an alternative to the current practice of using two open buckets and crushed ice in preserving fish freshness. We compared these methods by measuring seawater temperature, fish quality, and net income together with two local mobile fish sellers. We hypothesized that when the preservation method was efficient then the fish selling price could increase and the fish sellers could conduct selling activities for a longer period of time, leading to increased incomes.

The results showed that:

- The cooling solution kept fish at a lower temperature for longer than the current method;
- The fish sellers experienced an increase in income of 38 percent using the cooling solution, as it allowed sellers to carry more fish to sell;
- However, sales activity did not continue into the afternoon, since consumers perceive the fish sold in the afternoon to be no longer fresh and having a lower selling price.



Mobile fish sellers in Sikka regency, NTT province

# FISHERIES SECTOR IN INDONESIA

The fisheries sector in Indonesia plays an important role in supporting national food security as approximately 60 percent of the total population lives in coastal areas.<sup>1</sup> Indonesia marine catches increased by 67 percent from early 2000s to 2018. Being the third largest marine producer in the world, after China and Peru, Indonesia produces 6.71 million tons which contributes 8 percent of the global marine capture production.<sup>2</sup> A large portion of Indonesia's seafood (85 percent) is sold locally within the domestic market,<sup>3</sup> making seafood a key component of the Indonesian diet.

Due to poor management, nearly 40 percent of seafood produced in Indonesia is wasted.<sup>4</sup> The wasted seafood therefore represents a significant loss of potential nutritional resources.

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Source: <sup>1</sup>Natural resource aspects of sustainable development in Indonesia. <sup>2</sup>FAO (2020), The State of World Fisheries and Aquaculture 2020, Sustainability in action, Rome. <sup>3</sup>Ariansyach, I. (2018). Fisheries Country Profile: Indonesia. <sup>4</sup>Nurhasan, M (2019) Poor fisheries management costs Indonesia \$7 billion per year. Here's how to stop it.



Landing site functions as fish market in the morning in Sikka regency

A busy outdoor market scene, likely in a coastal or rural area. In the foreground, several motorcycles are parked in a row, with various items like white buckets, wooden crates, and green leafy vegetables tied to them. A person in a white tank top and blue shorts is walking away from the camera on the left. Other people are visible in the background, some standing near buildings and others near a body of water. The scene is captured in the late afternoon or early evening, with warm lighting and a slightly hazy sky. The text "PROJECT OVERVIEW" is overlaid in white, bold, sans-serif font on the left side of the image.

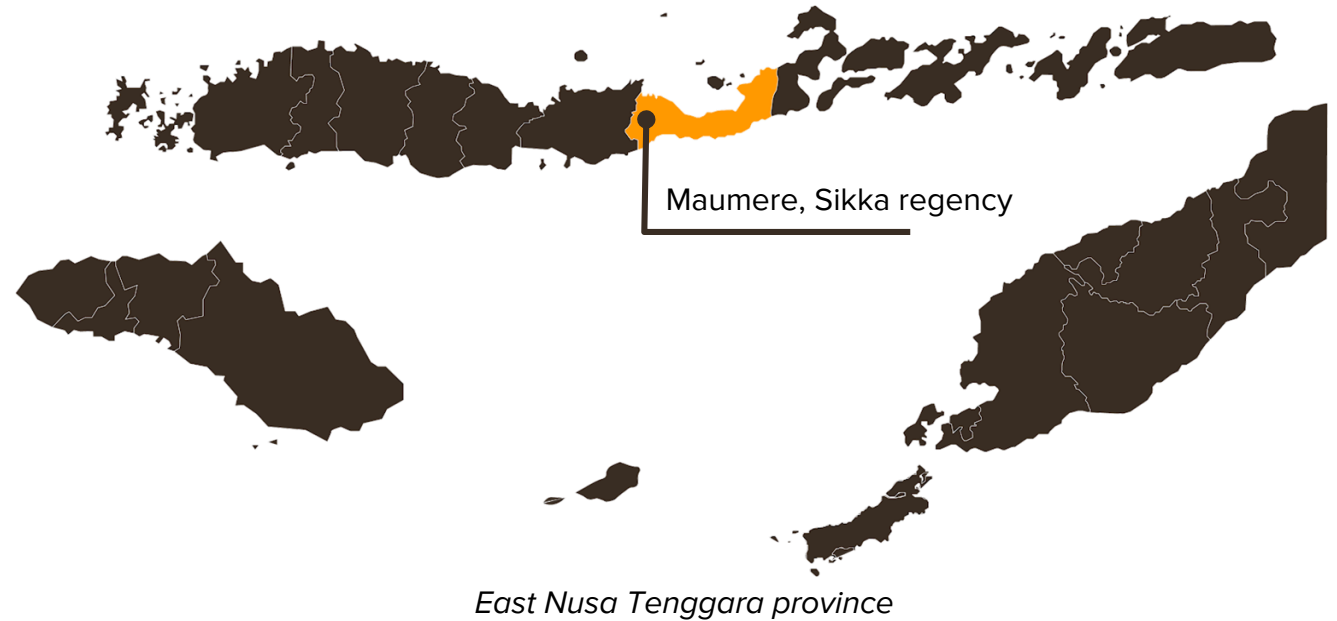
# PROJECT OVERVIEW

# CONTEXT

Mobile fish sellers transport fish on their motorbikes using two open buckets. These are often repurposed paint buckets that are attached to the back of their motorbikes. However, since the bucket size is small, sellers can only transport and sell a limited amount of fish. This practice is common amongst fish sellers in Maumere, Sikka Regency, NTT.

These buckets typically contain crushed ice and seawater, which is a common chilling process. Usually, the ice is purchased from home-kiosks and is sold in a plastic bag.

To maintain freshness, fish should ideally be kept at around 0°C. However, the current method does not keep the fish at a sufficiently low temperature, resulting in fish spoilage.



Mobile fish sellers use repurposed paint buckets

# CONTEXT

Fish sellers' daily activities start in the morning until noon.

## *Fish seller's daily activities*



6 AM



*Purchasing*

- Fish sellers in Sikka purchase fish from fishermen at the landing site around 6AM.



*Preserving*

- Fish sellers place the fish in buckets - containing crushed ice and seawater - which are then attached to their motorbikes.



7 AM



*Transporting*

- Sales activity begins. The fish is transported between villages for around six hours until just before noon.



1 PM



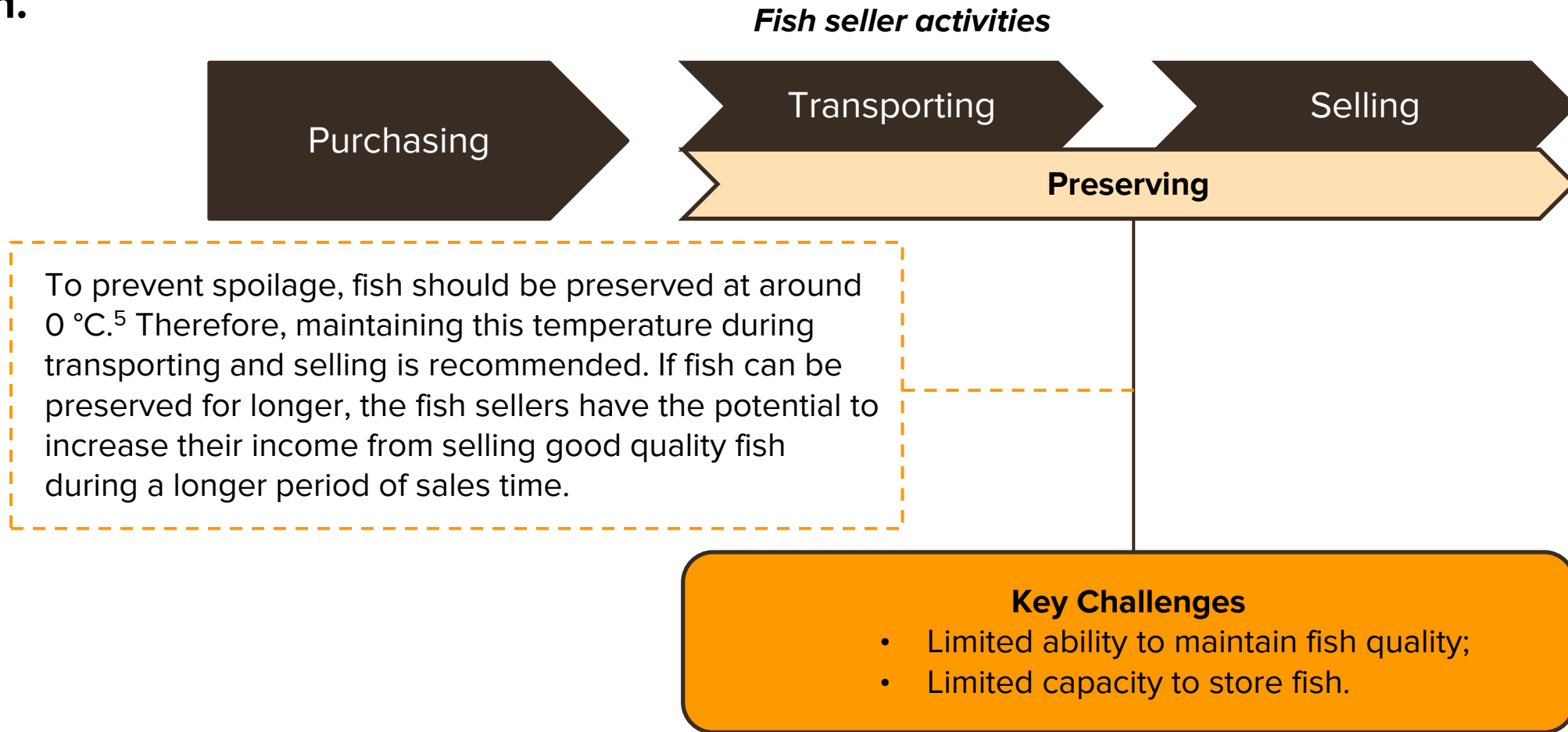
*Selling*

- Fish sellers go to two to four villages, located around 30 minutes from the landing site, to sell the fish.



# CONTEXT

Drawing on the challenges faced by mobile fish sellers, Kopernik's intervention aims to improve fish preservation by keeping a low temperature during transporting and selling of fish.



Source: <sup>5</sup>FAO (n.d). Improved fresh fish handling methods.

# HYPOTHESIS

We tested a cooling solution to improve fish preservation, which could lead to higher sales revenue and longer sales time, compared to the current method.



- Open buckets are generally preferred due to their practicality when selling fish.
- The sellers we partnered with in this experiment used two open buckets (one on each side of the motorbike).
- In the current method, the sellers only fill half of the bucket with fish to avoid spillage during transportation.
- Fish-ice ratio varies based on sellers' estimation.

Control  
(Current method)

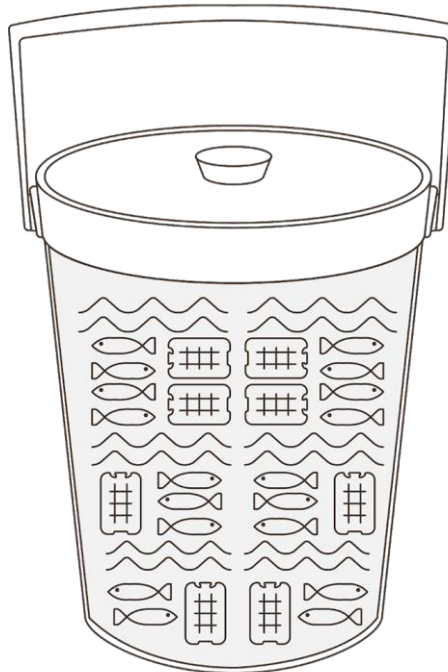


Ice



Seawater

Treatment  
(Cooling solution)



Fish



Gel packs



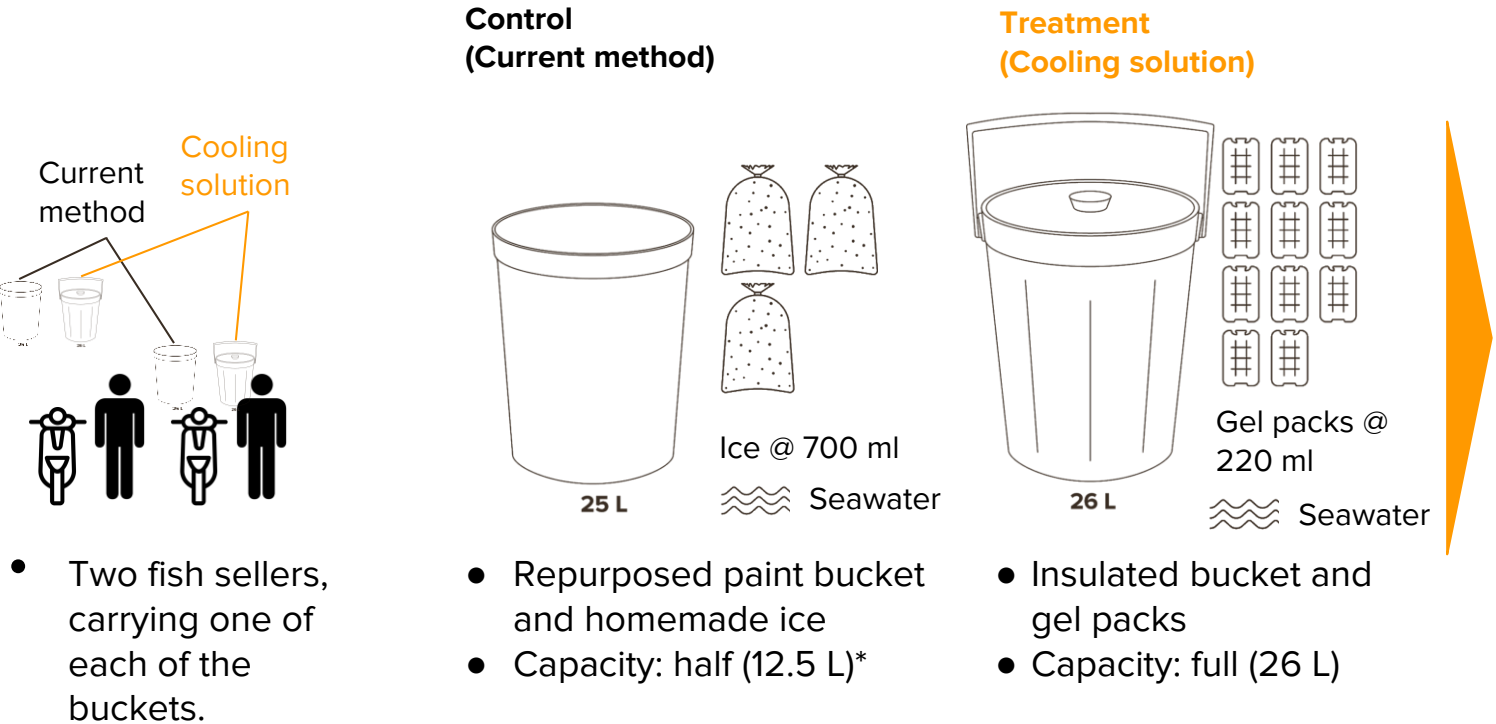
- The cooling solution consists of an insulated rice bucket and gel packs.
- We asked the fish sellers to keep the lid on the insulated bucket as it is necessary to maintain a lower temperature inside the bucket.
- Fish - Gel pack - water ratio is at 1:1:4

# EXPERIMENT DESIGN

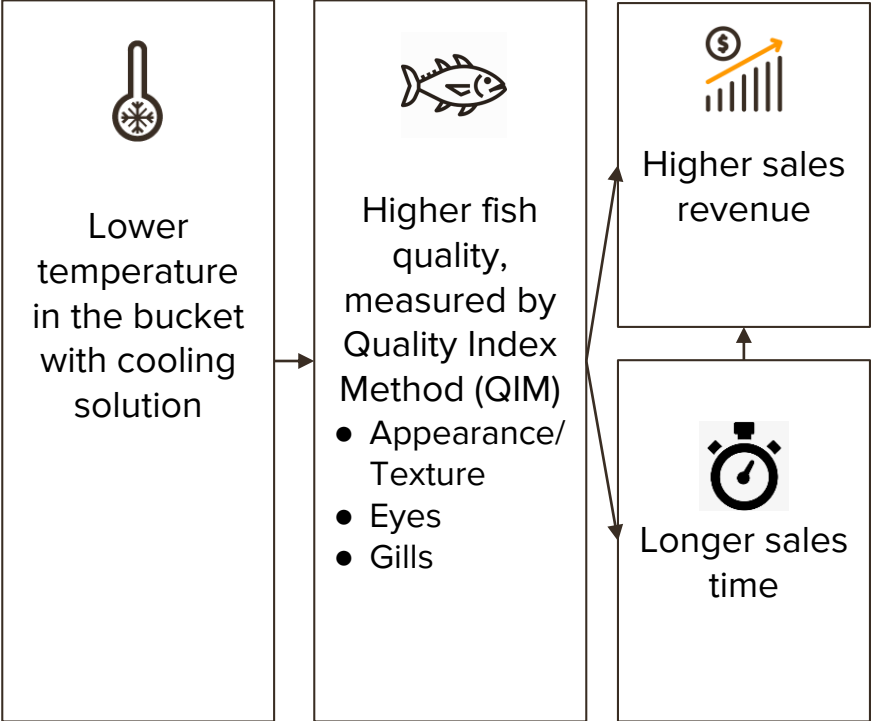
For both groups (control and treatment), we measured the seawater temperature and fish freshness, with each of the fish sellers conducting their sales activities using both methods.

Data collection period: 20 days over a two month period

## Experiment design



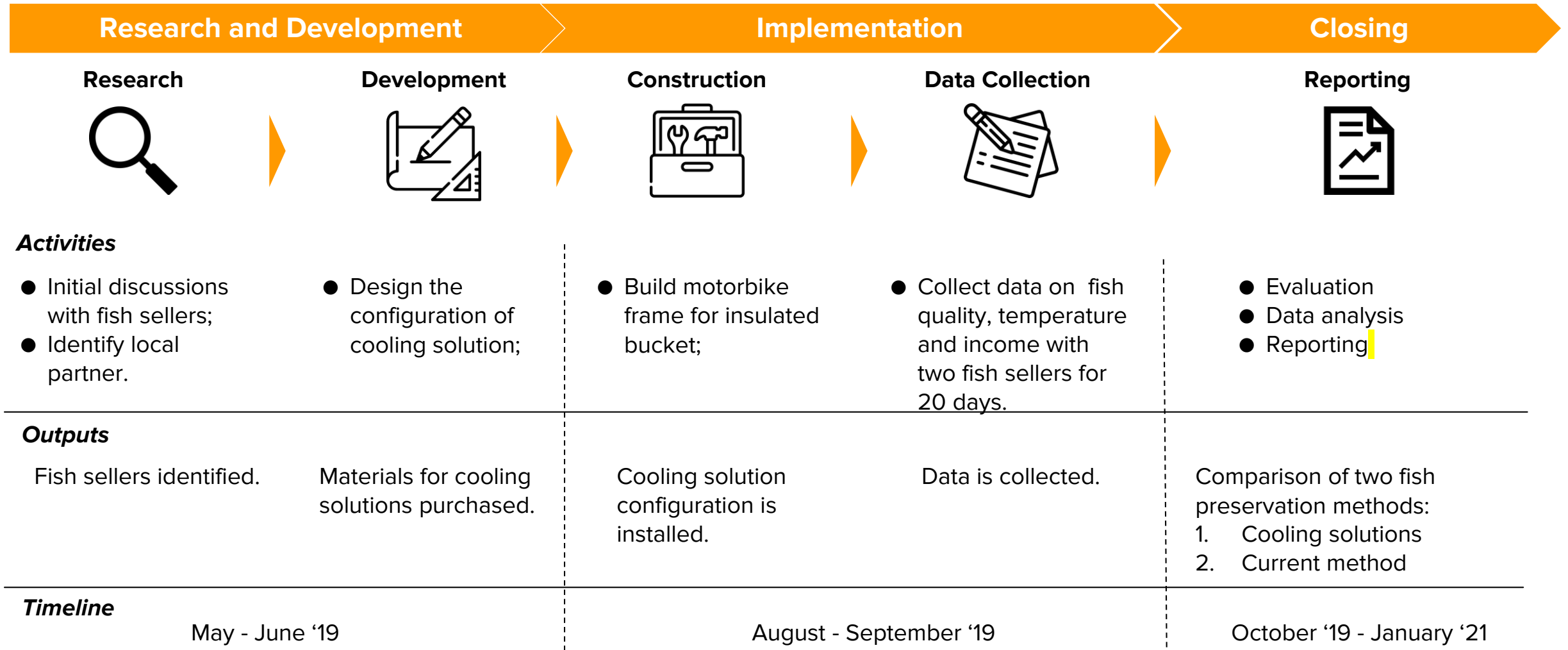
## Logic chain and assessment metrics



\* Fish sellers do not use a lid to cover the paint bucket so they only fill it halfway to prevent spillage.

# EXPERIMENT FLOW

The experiment, including the design, implementation and data collection, was conducted from August until September 2019.

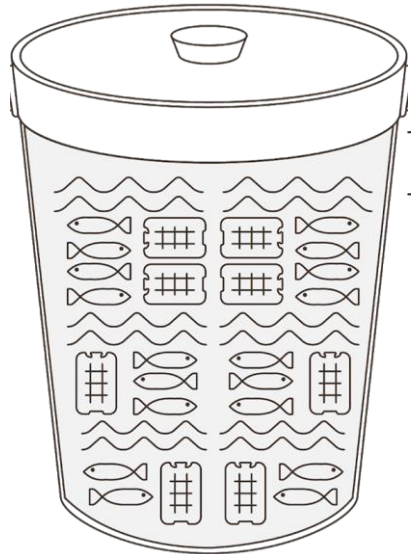


# FINDINGS



# TEMPERATURE

The cooling solution kept the fish at lower temperature than the current method during the sales period.

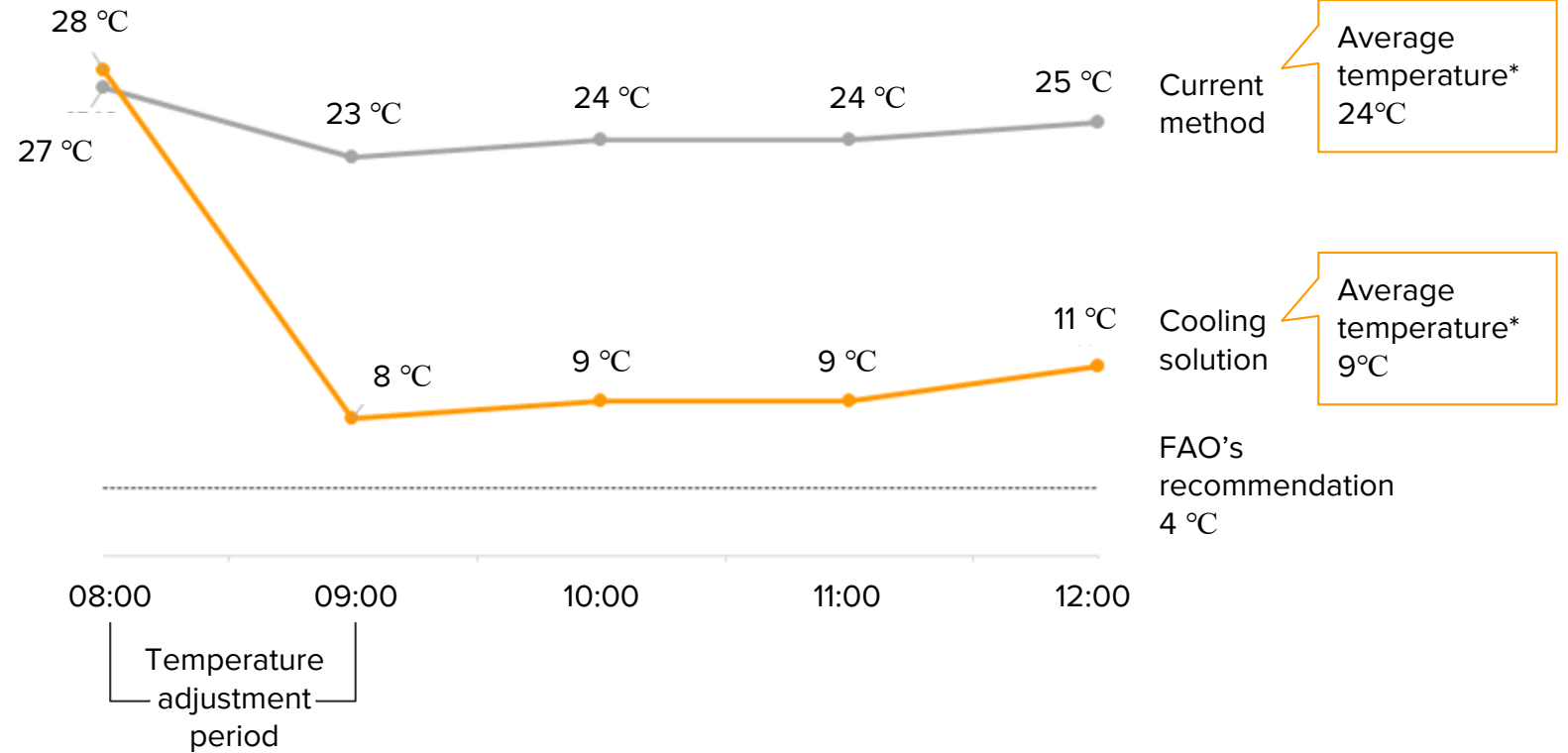


Level/depth of water where we measure the seawater temperature



## Seawater temperature

°C, (N=1)



\* Average temperature between 9:00-12:00 is calculated, excluding the temperature adjustment period.

# FISH QUALITY

The cooling solution resulted in fresher fish than the current method shown by the QIM score.

## Quality Index Method (QIM)

QIM is a metric developed to measure fish quality with various parameters by using specific guidelines to assess it over different periods of time.<sup>6</sup> In this experiment data was collected at noon.

Firmness of the body and its color (bright or pale)

**Appearance / texture**

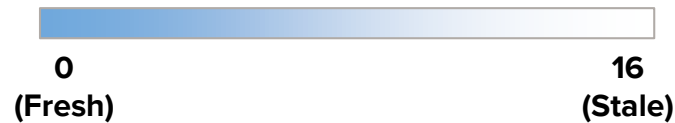
Clarity (clear or cloudy) and shape (normal or sunken)

**Eyes**

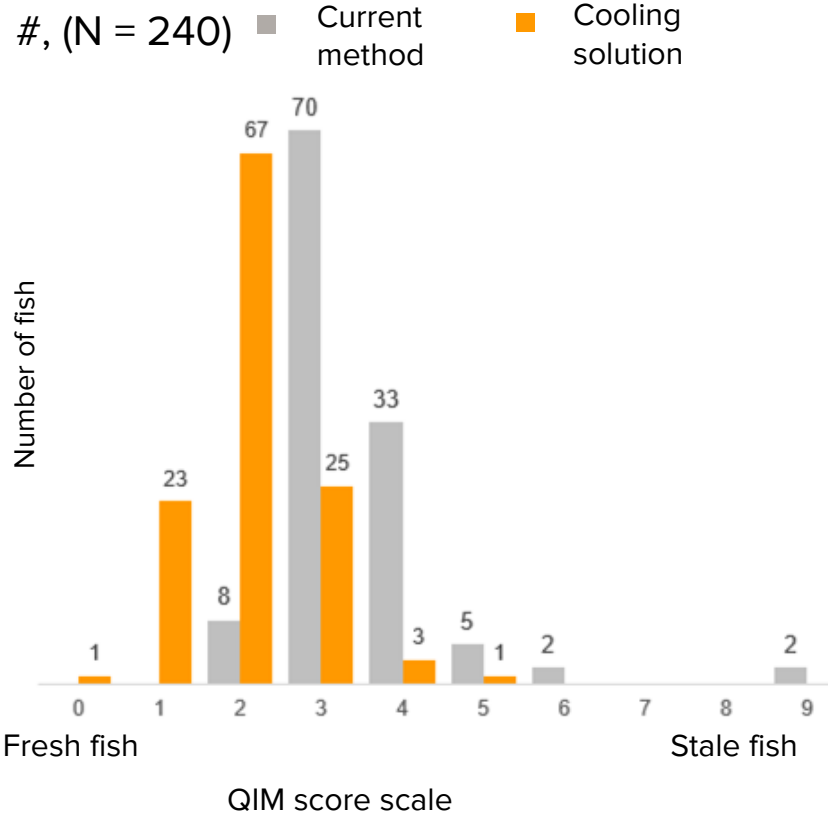


**Gills**

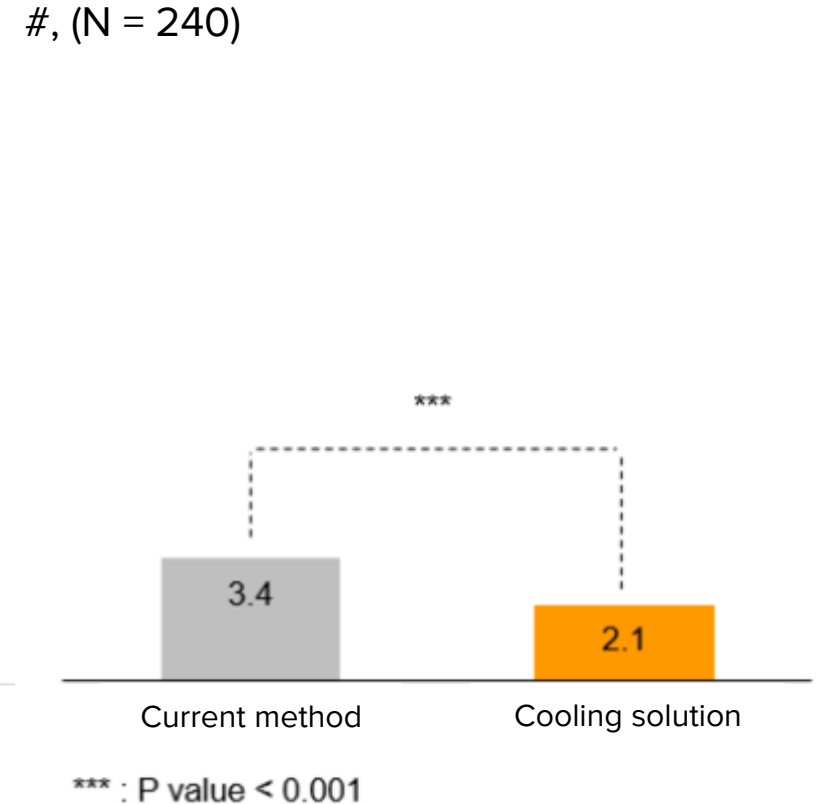
Thickness and color (red or pale)



## Fish QIM score distribution



## QIM score average



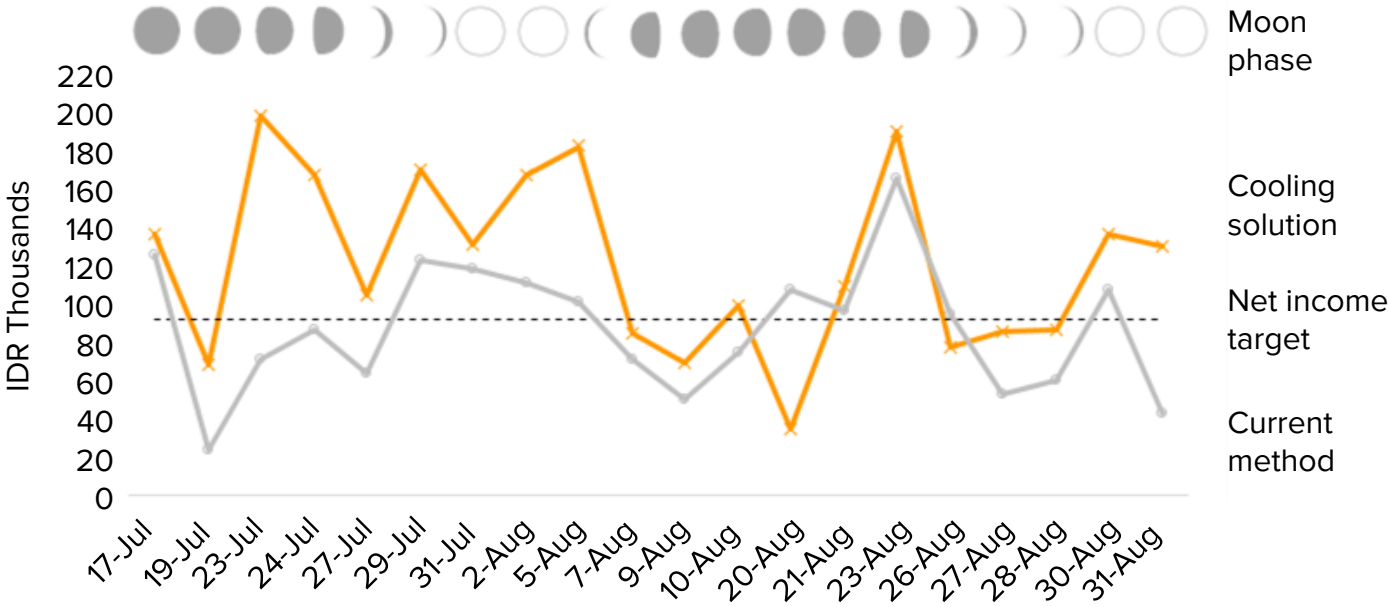
Source: <sup>6</sup> Lougovois, V. P., Kyranas, E. R., & Kyranas, V. R. (2003). Comparison of selected methods of assessing freshness quality and remaining storage life of iced gilthead sea bream (*Sparus aurata*). Food Research International, 36(6), 551-560.

# NET INCOME RESULT

The cooling solution resulted in an increase of average daily net income by 38 percent which was above MATA KAIL’s target of a 5 percent increase.

## Daily net income distribution

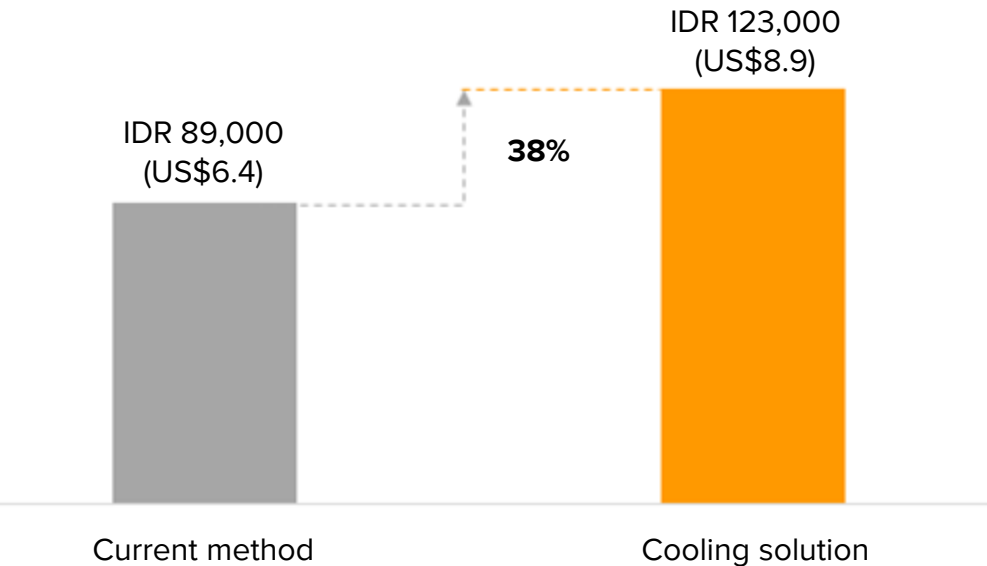
IDR, (N=2 fish sellers)



Normally, sellers buy fish at a higher price (from the middlemen) during the full moon – leading to fewer fish they can purchase.

## Average daily net income

IDR, (N=2 fish sellers)



We hypothesized that income increase would be gained from a higher sales price due to fresher fish, however, this was not proven in our experiment. The increment came from sales capacity that became doubled with the cooling solution.



# DURATION OF SALES

Despite the cooling solutions' ability to preserve fish for a longer time, the fish sellers did not prolong the duration of their sales activity.

## Daily sales time

Days, (N=2 fish sellers) ■ Morning sales ■ Afternoon sales








- Our findings showed that the fish sellers extended their sales activity beyond their usual sales time on **only one out of 20 days**.
- **Consumers avoid buying fish in the afternoon** as fish sold during this time of the day is perceived to not be fresh.
- Therefore our hypothesis that a better fish preservation technology would result in a longer sales period, was disproven.



# CONCLUSION AND RECOMMENDATIONS

# CONCLUSION

Overall, the cooling solution was effective to preserve fish freshness and contributed to an increase in income for the mobile fish sellers.

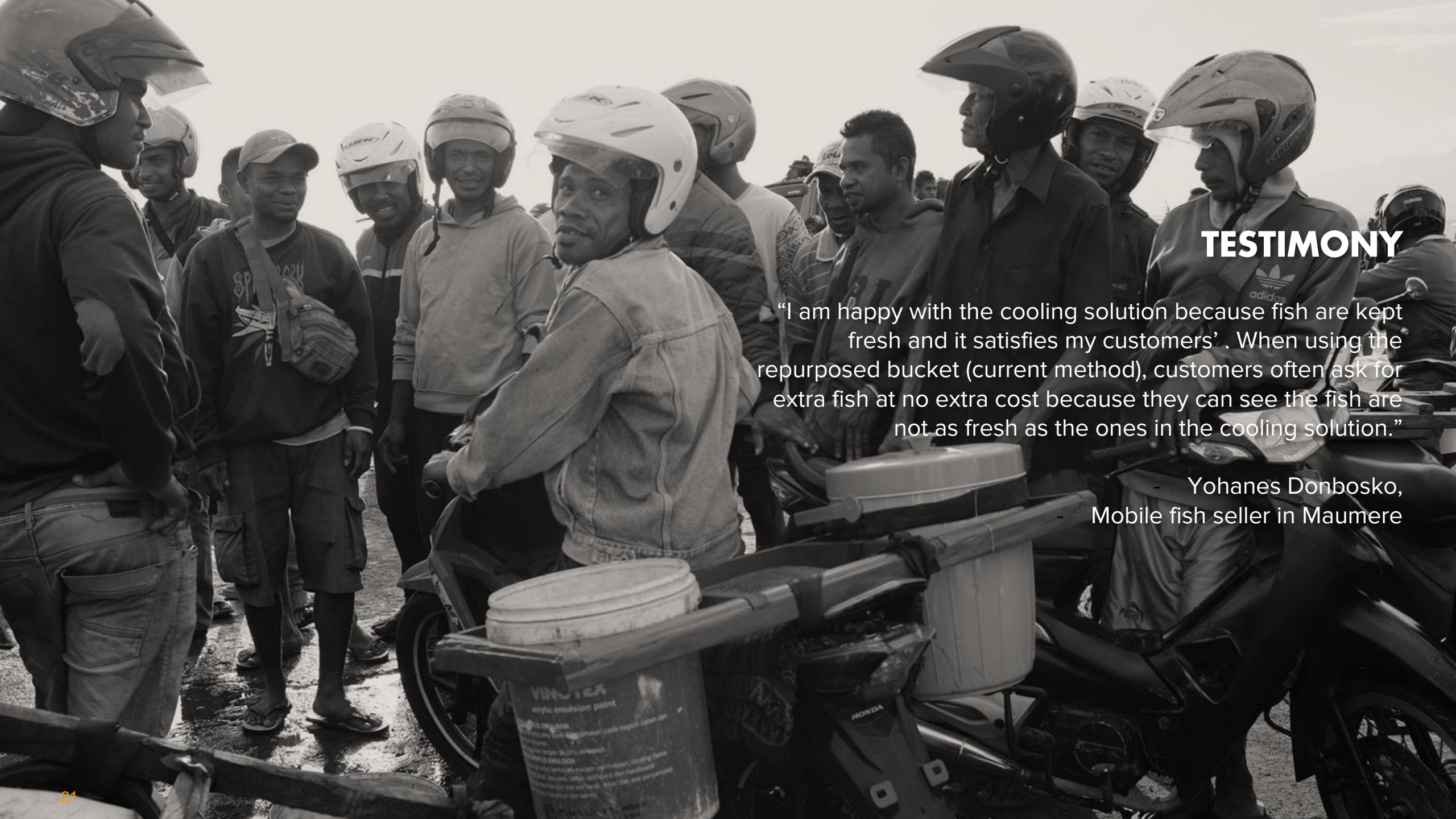
Key Findings	Description
 <p><b>Lower temperature</b></p>	<ul style="list-style-type: none"><li>Seawater average temperature in the cooling solution was lower, at 9 °C, compared to the current method (24 °C).</li></ul>
 <p><b>Higher fish quality</b></p>	<ul style="list-style-type: none"><li>The average QIM score of cooling solution was 2.1, lower than the current method with 3.4. This means that fish were kept fresher using the cooling solution.</li></ul>
 <p><b>Higher income</b></p>	<ul style="list-style-type: none"><li>The cooling solution yield net income increase by IDR 123,000 (US\$8.4) per day on average - exceeding the target income increase of the MATA KAIL project which was IDR 93,000 (US\$6.4).</li><li>This increase was not related to a higher selling price of fish as we hypothesized. It was due to the ability to fully fill the insulated bucket meaning the fish sellers could carry more fish.</li></ul>
 <p><b>Similar sales time</b></p>	<ul style="list-style-type: none"><li>The sales time was not extended, the fish sellers continued to sell for the same period of time.</li></ul>
 <p><b>Additional environmental benefit</b></p>	<ul style="list-style-type: none"><li>An additional benefit from the cooling solution was reducing the use of single-use plastic to sell ice, by switching to reusable gel packs.</li></ul>

# RECOMMENDATIONS

Based on the results of this experiment, Kopernik recommends the following:

- Repurposing the rice bucket which already comes with a lid for sales capacity increment and maintain low temperature during sales activity;
- Establish a hub in NTT to provide gel packs that can easily be accessed by mobile fish sellers;
- Improve the cooling solution design to enable a more convenient and attractive fish display. The current design places the fish at the bottom of the insulated bucket covered with gel packs, making it difficult for customers to see the product; and
- Conduct further studies to assess consumers' fish purchasing behavior to identify factors that influence their purchasing decisions.





## TESTIMONY

“I am happy with the cooling solution because fish are kept fresh and it satisfies my customers’. When using the repurposed bucket (current method), customers often ask for extra fish at no extra cost because they can see the fish are not as fresh as the ones in the cooling solution.”

Yohanes Donbosko,  
Mobile fish seller in Maumere

# ANNEX 1: A HUB FOR GEL PACK SUPPLY

Building on this experiment, there is an opportunity to build a gel pack cooperative/hub among fish sellers to cover the initial investment for a cooling solution that can lead to higher incomes.

## Cooperative scheme breakdown

Initial investment to be shared among five fish sellers

Item	Total Cost (IDR)
Freezer (100 liter capacity) 1 unit	2,220,000
Voltage stabilizer 1 unit	370,000
Gel packs (375 ml) 125 units	2,875,000
<b>Total</b>	<b>5,465,000</b>

Badan Usaha Milik Desa (Village Owned Enterprise, also known as BUMDes) could be suitable to set up this gel pack cooperative/hub.

## Two-year projection with 6-months installments for Cooling Solution

Cooling Solution (CS) compared with Current Method (CM)

