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FINDING WHAT WORKS

IMPROVING FISH PROCESSING: SHREDDING MACHINE

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 Shredding Machine 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.

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EXECUTIVE SUMMARY

Fish floss is a light and fluffy fish product that is popular in East Nusa Tenggara (NTT). The production of fish floss involves shredding the fish, and many MSMEs in NTT use labour intensive manual methods.

Kopernik partnered with Kembang Baru, an all-women small enterprise in Sikka, East Nusa Tenggara, that produces fish floss. We compared manual and mechanized shredding processes by measuring the labour and time required. We then developed income projections based on the improved efficiency and the potential to increase production capacity.

The results showed that:

- The use of a shredding machine can decrease the shredding time by 40 percent and reduce the amount of labor required;
- Although the machine makes the shredding process less labor-intensive, the workers still need to perform a final manual shred to achieve the ideal product consistency. However, the manual shredding time is significantly reduced, as previously they had to manually shred four times.

A worker is preparing tuna before start making fish floss

PROJECT OVERVIEW

CONTEXT

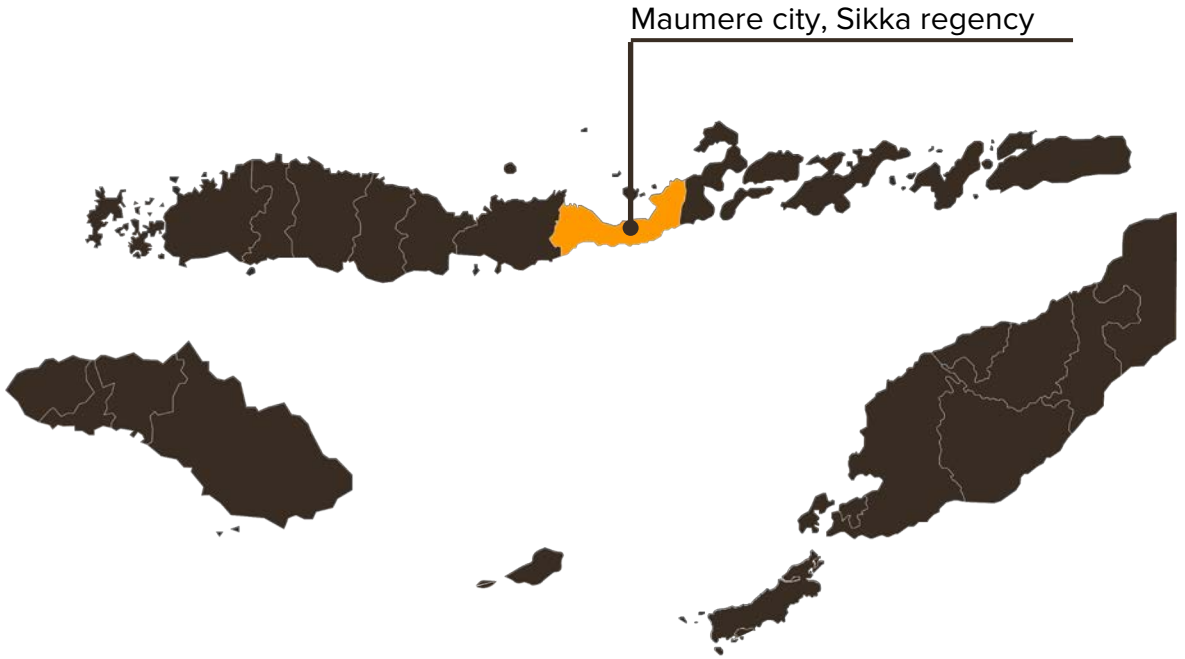
Despite contributing 10 percent of national fish production, East Nusa Tenggara (NTT) has one of the lowest number of MSMEs of any Indonesian province. One of the most popular fish products in NTT is a light and fluffy product called fish floss. The production of fish floss comprises several stages.

One of these stages is shredding, which is crucial in getting the fish floss to be the right consistency. Kopernik's Market Demand Research (MDR) report found that many MSMEs use manual methods to shred the fish.

In this experiment, Kopernik worked with Kembang Baru, an all-female small enterprise in Maumere district, East Nusa Tenggara province, Indonesia. Kembang Baru sells various fish-based products, one of which is fish floss. Since 2003, Kembang Baru has been using oil strainers to shred the fish (tuna) before they cook it into the final product. Usually, the workers need to repeat the shredding process four times to reach the desired consistency. This is very labour intensive and less efficient than using more modern tools.

Based on this, we tested a small-scale machine to make the shredding process more efficient, reducing time and the number of workers required to shred fish.

Kopernik. (2019). Market Demand Research Report.

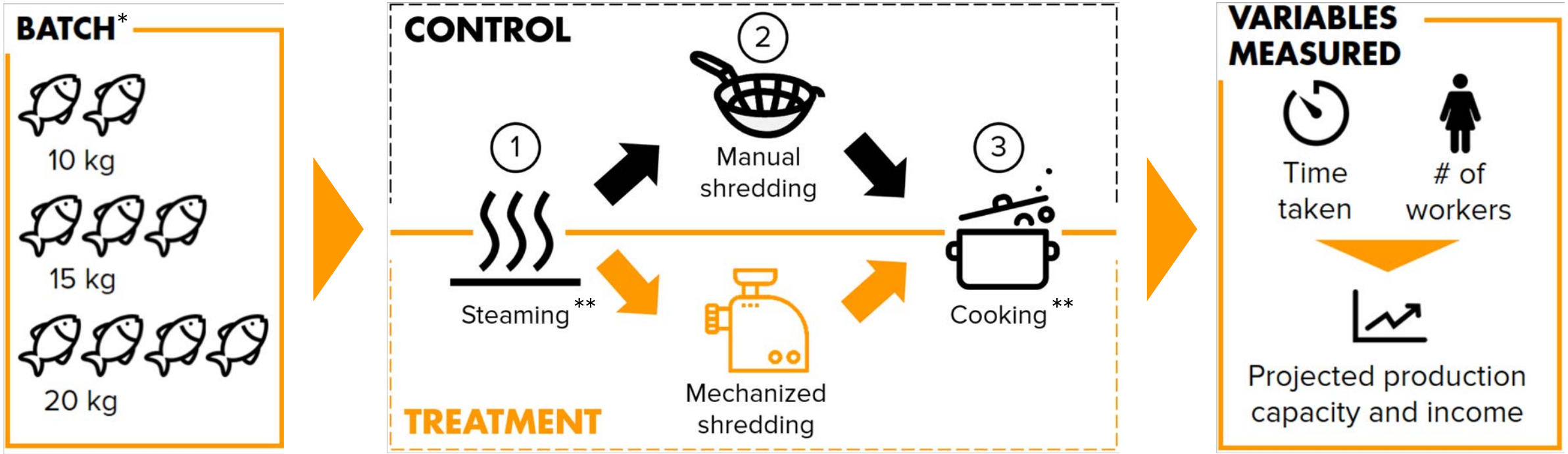


East Nusa Tenggara province

HYPOTHESIS

We hypothesized that the shredding machine would:

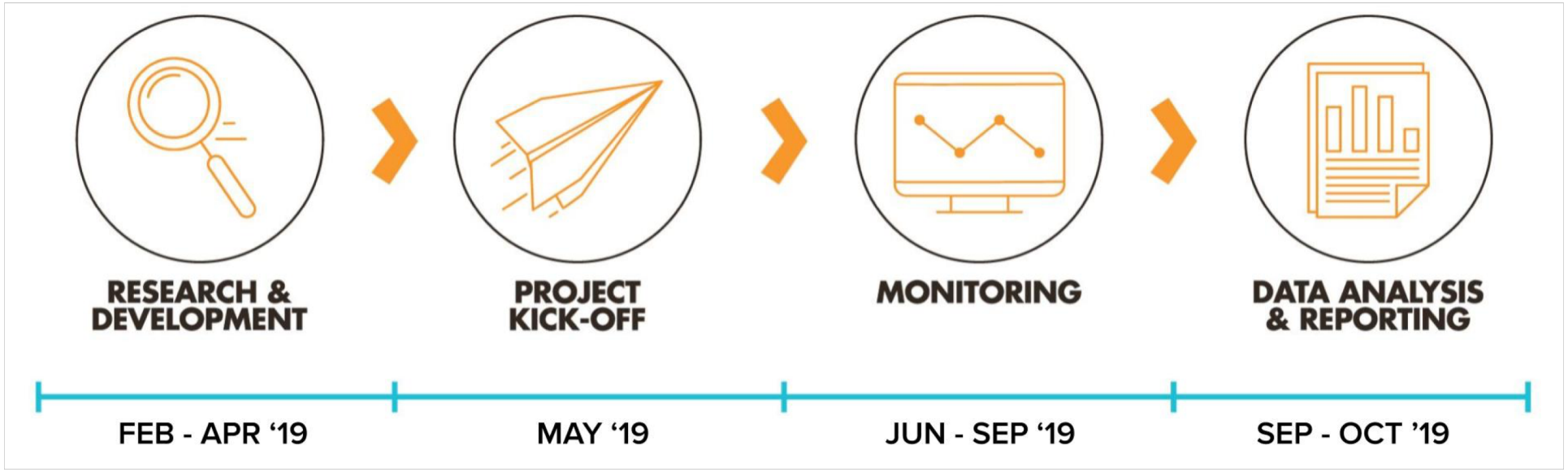
1. **Reduce the operational effort (time and number of workers) during the fish shredding stage.**
2. **Increase the production capacity of the fish floss MSME which will lead to increased net income.**



* We experimented with these batches and amounts of input based on the normal production capacity of the MSME that we partnered with.
** The reason why we also measure the time taken for the steaming and cooking stages was so that we could calculate the contribution of reduced shredding time to the overall process, as these three processes are the most time intensive during the fish floss production process

EXPERIMENT FLOW

This was an eight-month experiment. We collected data from June to September 2019.



	FEB - APR '19	MAY '19	JUN - SEP '19	SEP - OCT '19
Activity	• Design of experiment • Procurement of the shredding machine	• Installation of the shredding machine	• Data collection x 6 • Collected data: time and number of workers	• Evaluation • Data analysis • Reporting

THE SHREDDING MACHINE

For this experiment, we purchased a small-scale shredding machine from East Java. The machine has a dynamo (generator/alternator) that connects to the blades inside. Once connected to a power source and turned on, the dynamo will make the blades rotate rapidly which will shred the fish.

We engaged a local technician to produce a similar machine to see whether it is possible to locally produce this machine at a competitive price. The price of the ready-made machine is IDR5,000,000 or US$356.40 (excluding IDR2,415,000 or US$172.14 shipping and packing fee) while the locally assembled one is IDR7,475,500 or US$532.86 (all-inclusive). The cost of procuring the machine from East Java or producing locally was therefore similar.

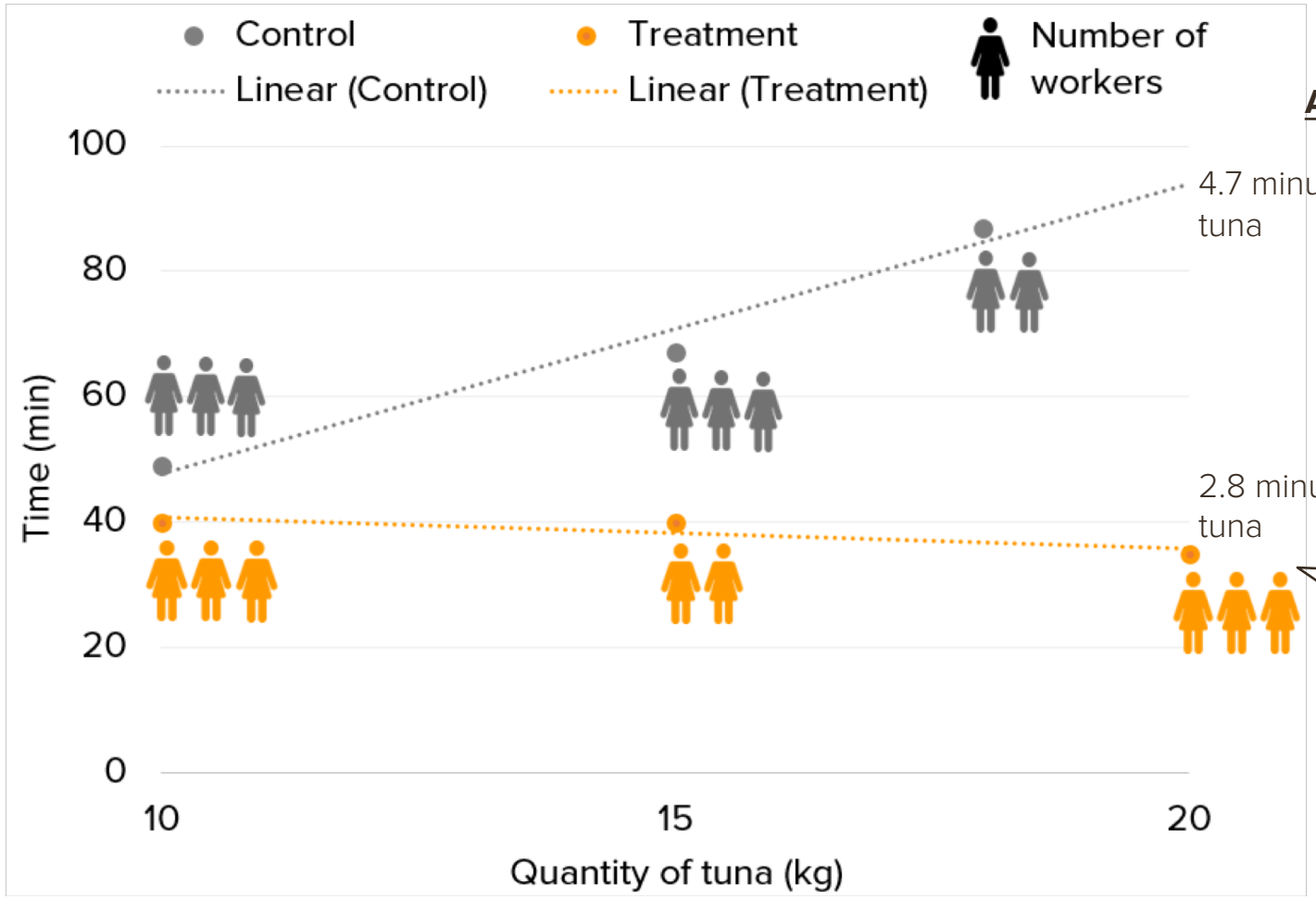
The shredding machine

FINDINGS

SHREDDING TIME AND WORKLOAD

The machine reduced shredding time by 40 percent and reduced the number of workers required for this process. However, the workers needed to repeat the shredding process three times to obtain the desired product consistency.

Shredding time of control and treatment groups



Average

4.7 minutes per kg of tuna

2.8 minutes per kg of tuna

Note:
The quantities of tuna processed varied slightly from the experiment design.

They were:
- **Control:** 10, 15 and 18 kg
- **Treatment:** 10, 15 and 20 kg

Shredding time per kg decreased with increased volumes of fish. This may be due to the different number of workers for each batch, and/or an increase in efficiency as they became accustomed to using the machine.

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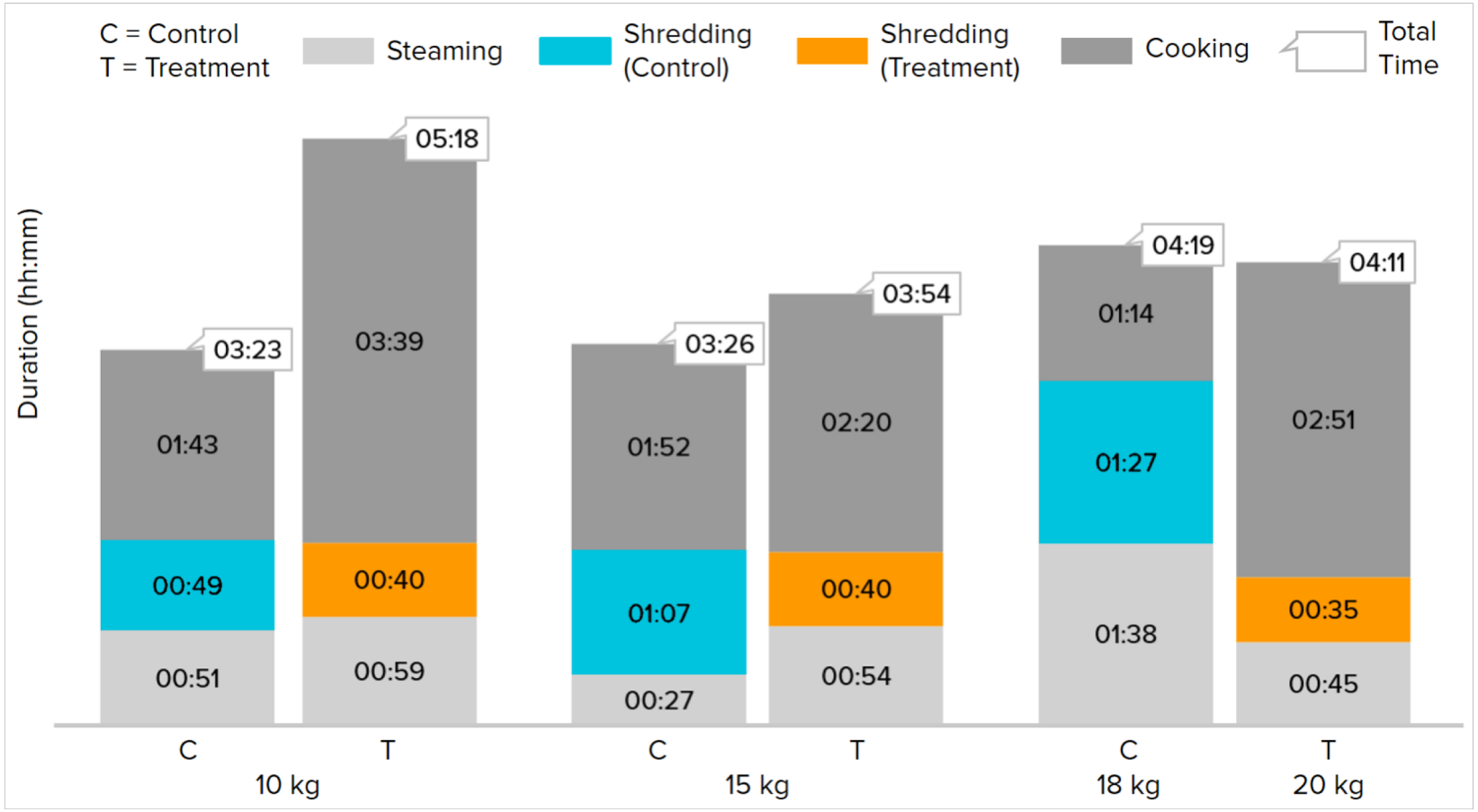
PRODUCTION TIME

A shorter shredding time, however, did not decrease the overall production time due to variations in the cooking methods for each batch.

Actual production time of both groups



Limitations:

The use of different stoves led to different steaming and cooking time. We tested a biomass stove as an alternative for the workers to use as they were using an open pit cook stove. The workers used this stove for a while, but went back to steaming with an open pit stove as this provided more heat and was the preferred method.

The inconsistent use of multiple stoves led to different steaming and cooking times. When the fish quantity was around 15 kg or more the workers utilised a second stove to reduce the cooking time.

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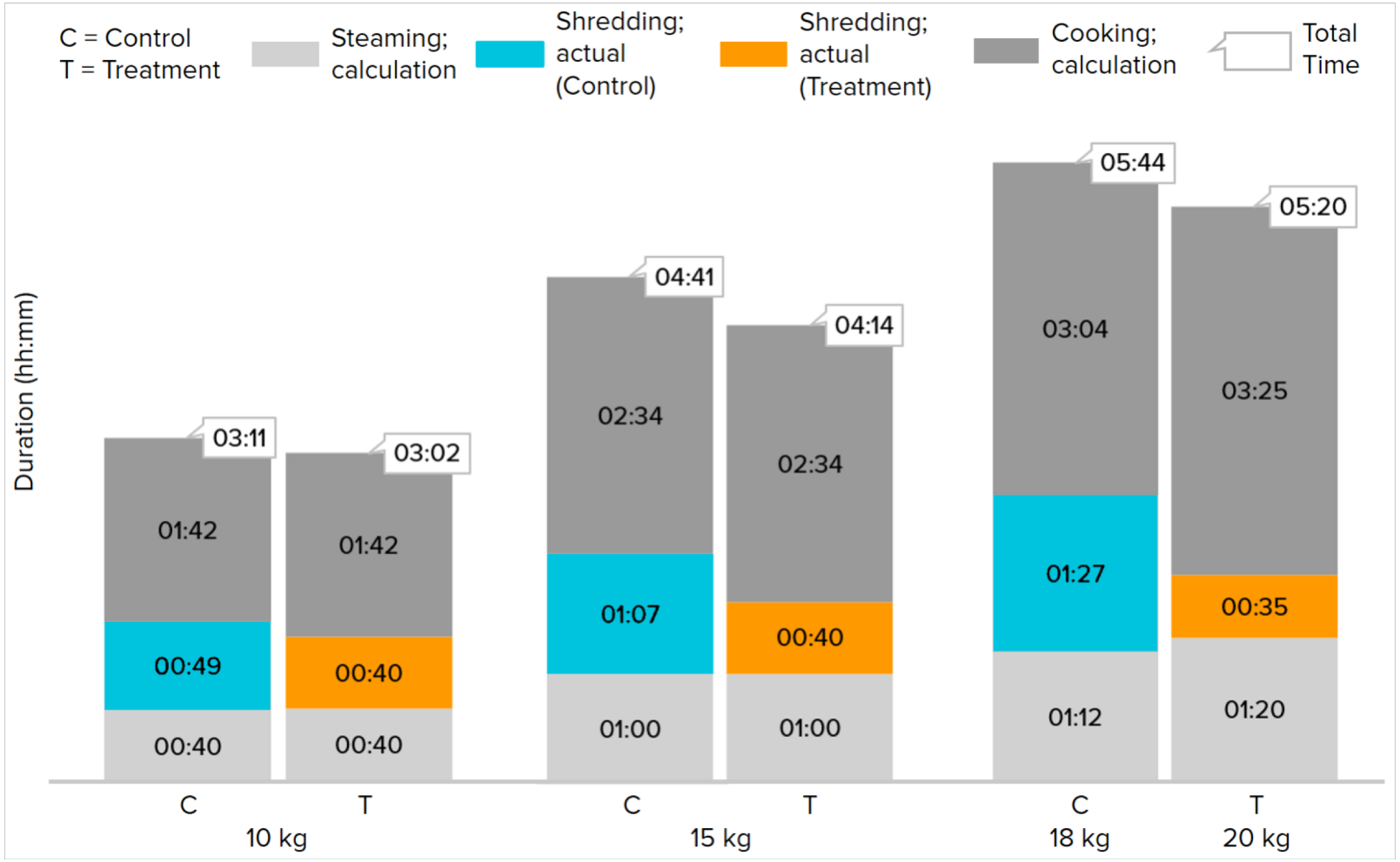
PRODUCTION TIME

Using normalization to accurately compare the different methods, we found that the shredding machine slightly reduced the overall production time

Adjusted production time of both groups



Normalisation Method:

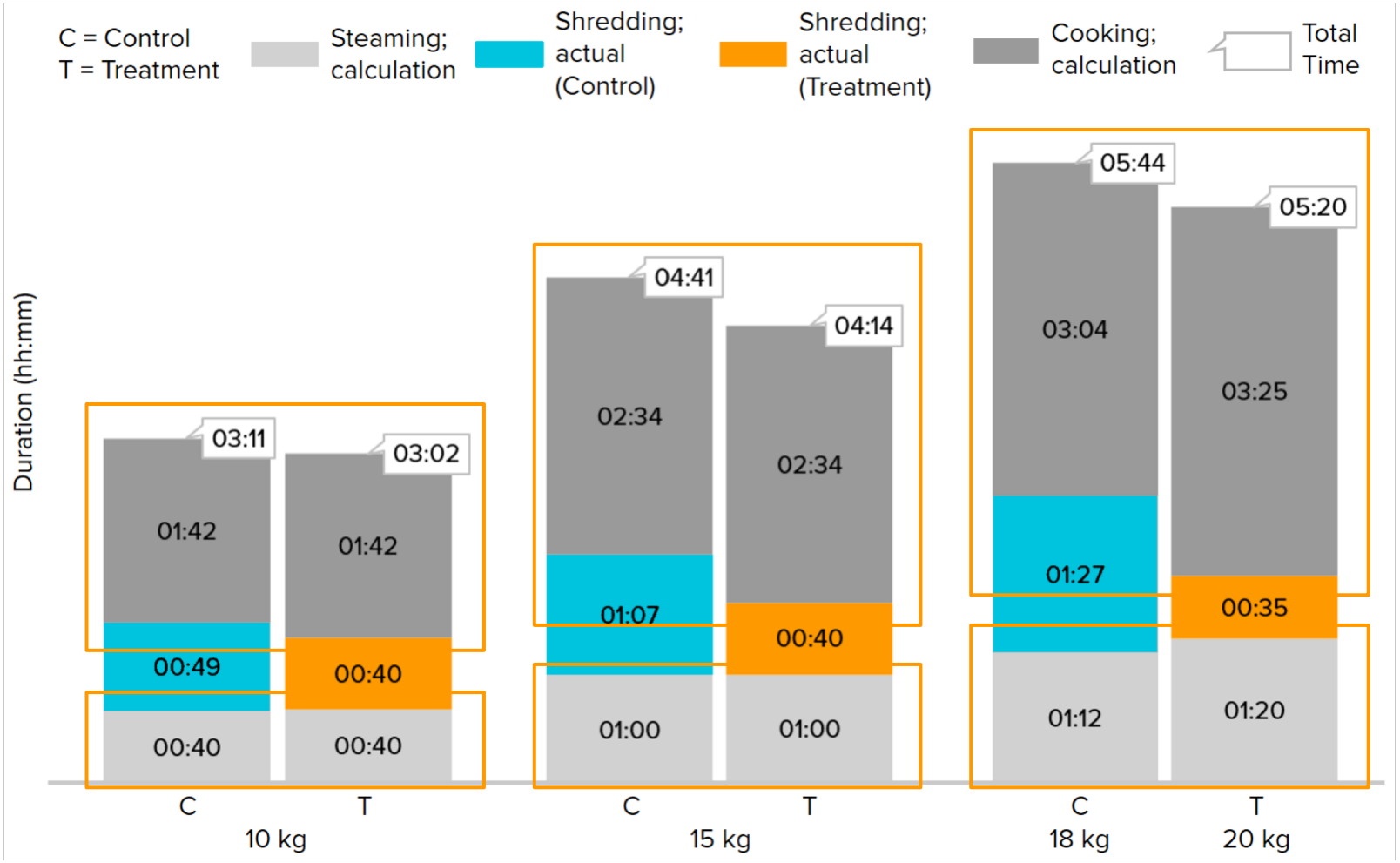
To enable us to compare the two methods, we calculated the ideal steaming and cooking time by averaging the actual time of each batch and normalising it for the fish input quantity. Then we added the ideal steaming and cooking time and the actual shredding time to obtain the overall production time. The processing time should increase in line with an increase in the amount of fish input.

Normalised results showed the fish floss production time with the shredder is slightly lower compared to the manual process which was in line with our hypothesis. The time decrease also becomes more significant as the production capacity increases.

PRODUCTION TIME

Normalized results show that the steaming and cooking stages are up to six times more time consuming than the shredding stage.

Adjusted production time of both groups



Steaming and cooking stages could be improved

The shredding stage only accounts for 16-25 percent of production time while the steaming and cooking stages account for 21-23 and 54-60 percent respectively. Thus, improvements in steaming and cooking stages can be made to further reduce the time needed for both stages.

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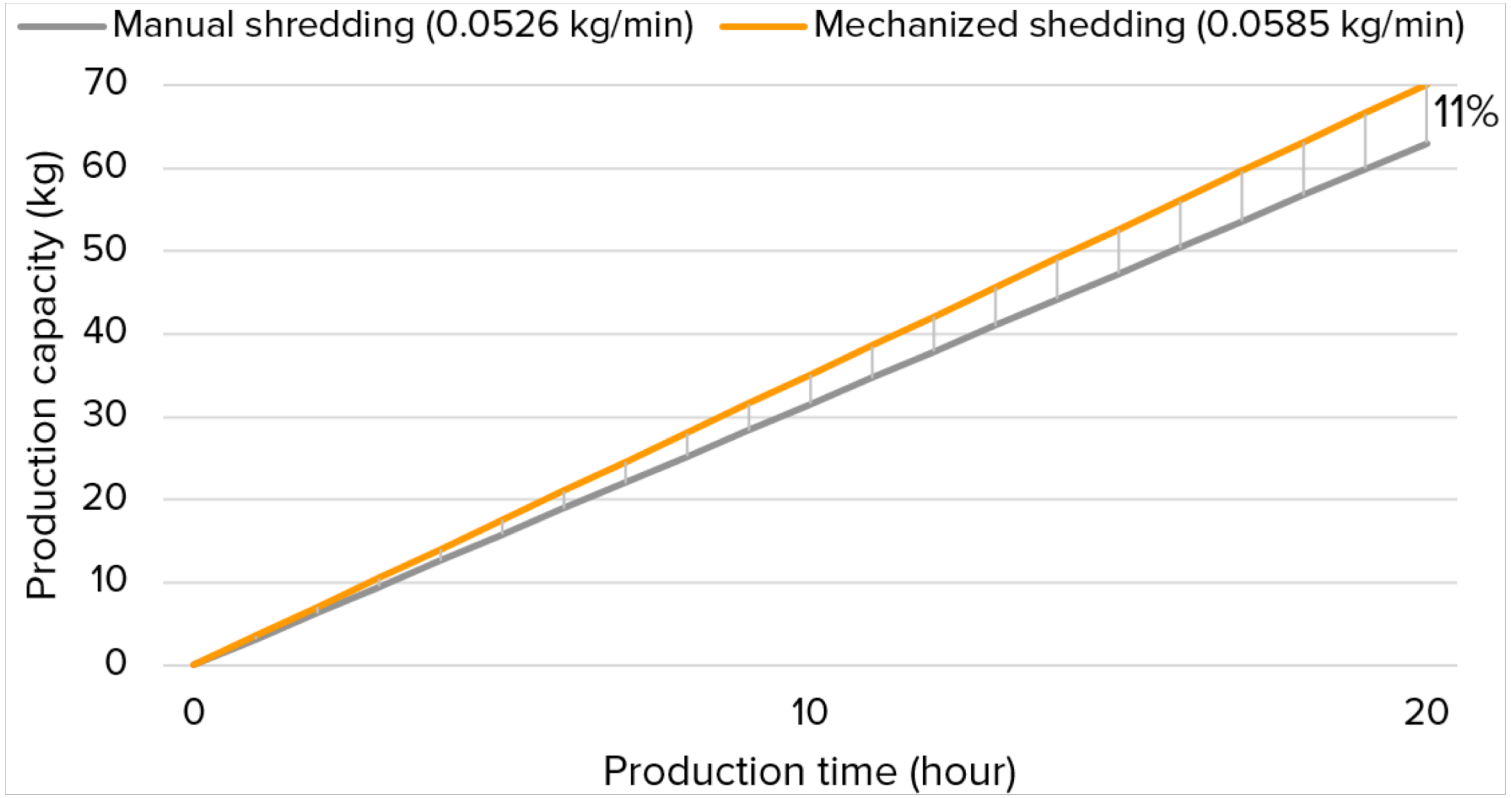
PRODUCTION CAPACITY

The machine can potentially increase production capacity by 11 percent, thus enabling workers to process an extra three kilograms of fish during an eight hour work day

Production capacities using two different shredding methods



Assumptions

The fish floss is produced once every two weeks (the average production frequency based on interviews with Kembang Baru workers)

The workers work for a maximum of eight hours per day

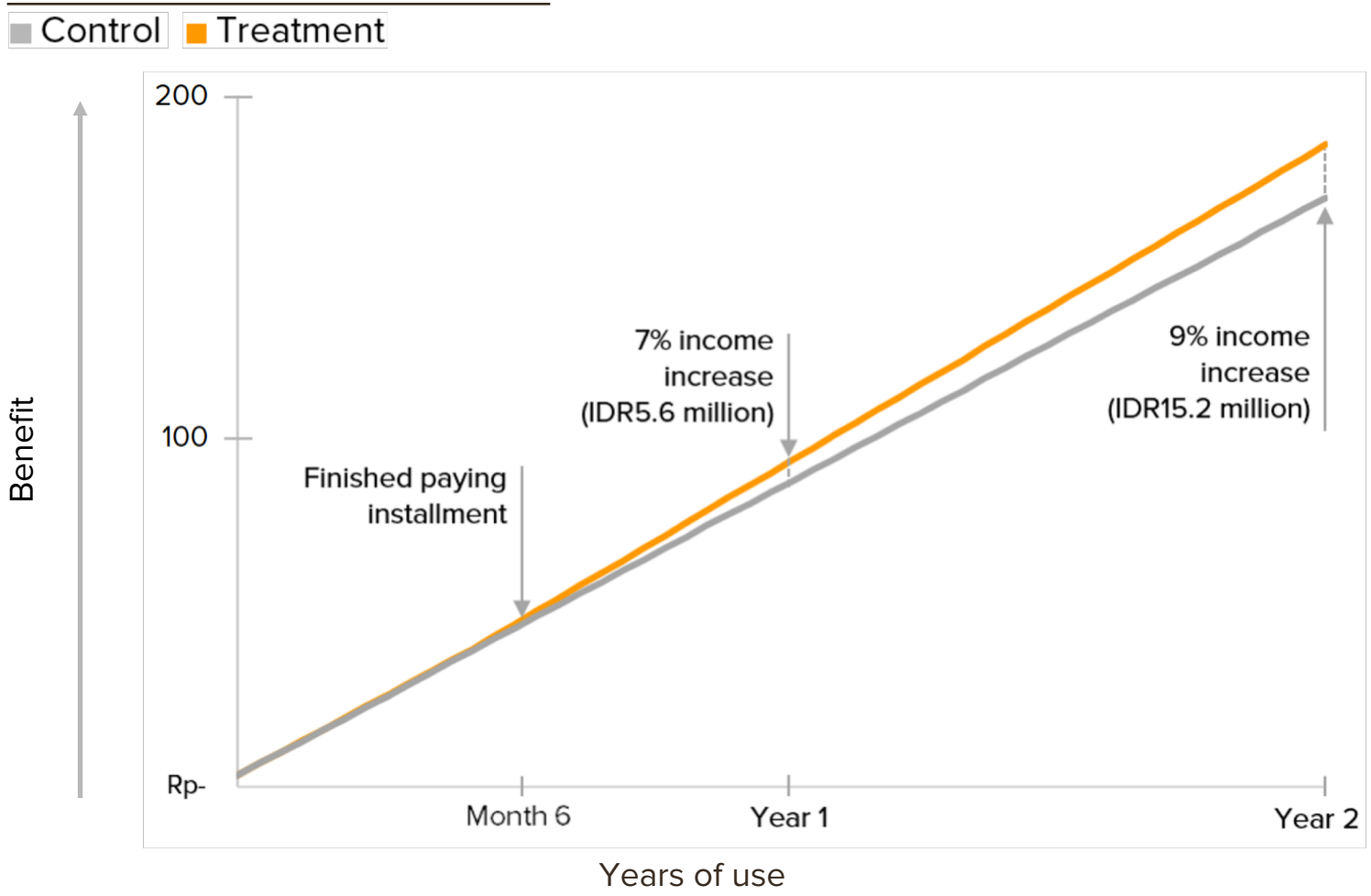
The workers are paying for the shredding machine in installments of IDR1.3 million (US$94) monthly over six months for a total price of IDR7.9 million (US$566) in total

There is no decrease in sale price due to increased production

INCOME INCREASE

The machine could increase income by 9 percent after two years. While these figures may seem modest, IDR15.2 million (US$1,083) is equivalent to 70 percent of the annual minimum wage in NTT.

Income increase projection



Assumptions

Workers process an extra 3 kilograms of tuna per day

The fish floss is produced once every two weeks (the average production frequency based on interviews with Kembang Baru workers)

The workers work for a maximum eight hours per day

The workers are paying for the shredding machine in installments of IDR1.3 million (US$94) monthly over six months for a total price of IDR7.9 million (US$566) in total

There is no decrease in sale price due to increased production

TESTIMONY

“I find the machine really helpful; it makes the shredding process much easier and faster. It is also easy to operate. However, it would be hard for us to get another machine if this one breaks down as the price is quite expensive” - Agnes Wangi, Leader of Kembang Baru Group

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CONCLUSION AND RECOMMENDATION

Fish floss

CONCLUSION

This experiment suggested that the shredding machine made the shredding process more time and labor efficient, and had an increase in production capacity. On average, the shredding machine required 40 percent less time to shred fish as compared to the manual method.

The adoption of a shredding machine could increase the overall production capacity by 11 percent and potentially increase net incomes by 9 percent after two years. Despite being more efficient, further refinement of the shredding machine is needed to improve the result and remove the need for repeated shredding (the fish had to be shredded three times) to obtain a good product consistency.

NEXT STEPS

While the shredding machine saved time during the shredding process, the overall production time is still long. Other technologies should be explored to save time during the steaming and cooking stages of fish floss production.