IMPROVING PROCESSING TECHNOLOGIES: PALMYRA LEAF CUTTER

EXPERIMENT RESULTS

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KOPERNIK

SUMMARY

East Nusa Tenggara has a centuries-long tradition of basket weaving. The climate of this area creates a conducive environment condition for palmyra palm (*Borassus flabellifer*), or *lontar* in Indonesian, to grow naturally[1] - which is one of the natural materials used for basket weaving. *Lontar* basketware is considered as relatively rare due to the plants' availability, and most *lontar* weavers are women who make custom-ordered products[2] in their homes in between doing other domestic work. Realizing the potential of the weaving sector, and the need to support women weavers, Du'Anyam (a social enterprise which focuses on women's empowerment and health improvement), works with more than 900 weavers across Flores, Kalimantan, and Papua. Founded in 2014, Du'Anyam started their work in East Flores, East Nusa Tenggara province, and own a Weaving House or *Rumah Anyam* in Wulublolong Village which is their main weaving center. However, during the production process, they identified a challenge in the process of cutting the palmyra leaves into strips. The weavers currently use a simple knife to cut the leaves, an inefficient and time-consuming process which results in inconsistent widths of the strips, leading to lower quality products as well as wastage.

Kopernik partnered with Du'Anyam to find a solution to improve this process. Kopernik developed the first palmyra leaf cutter prototype (Figure 1), based on inputs from Du'Anyam. After the prototype was finished, we installed it at *Rumah Anyam* and collected data to see whether the leaf cutter could generate a higher number of more consistent strips compared to the current method of using a knife.

Our experiment concluded that :

- This prototype generated less consistent strips than the manual method. This occurred because long pieces of steel were needed (1.5 meters) for the cutting plate and the welding process to connect the steel resulted in a cutting plate that was not straight.

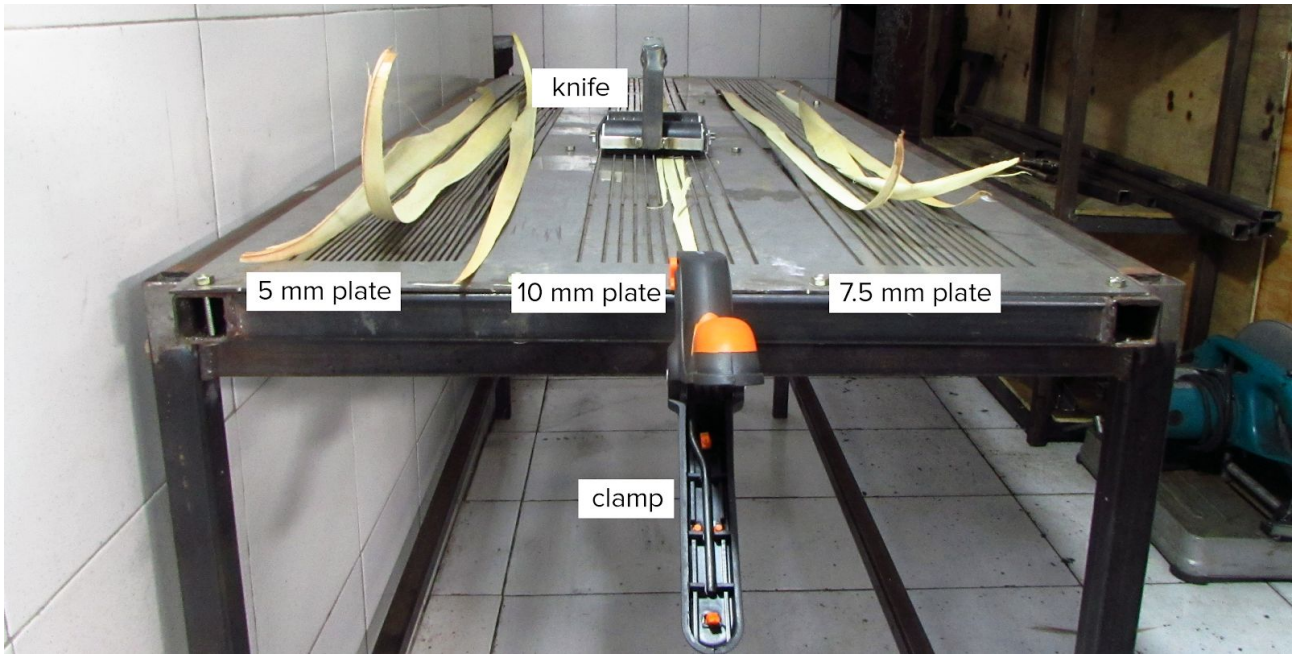
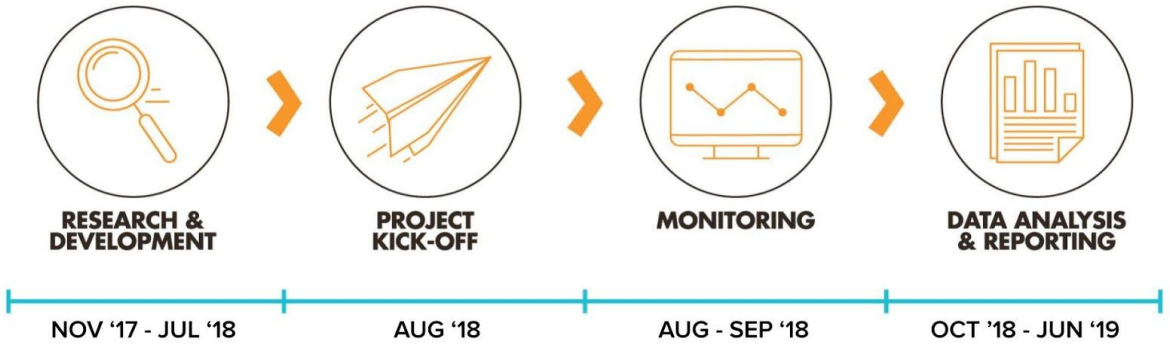


Figure 1. The leaf cutter prototype

[1] Indonesian Agency for Agricultural Research and Development
[2] Indonesian Trade Research and Development Agency

TIMELINE



CONTEXT

The basketware industry is a big market with three main export destinations; the United States, the European Union, and the Asia-Pacific region.[3] In 2018, Indonesia exported more than US$80 million worth of basketware and wickerwork globally.[4] The export value of basketware is a significant contributor to the national economy.

East Nusa Tenggara, in particular East Flores is one of the largest producers of basketwear in Indonesia. Basket weaving is a big industry comprising primarily of workers in the informal economy. It is a popular job chosen by women with families because they can work flexibly from home. It is also a job that can be done throughout the year as the raw materials are locally available and are not season-dependent. [5]

The biodiversity and climate of East Nusa Tenggara are conducive to basket weaving activities.[6] One of the essential natural materials used for basket weaving are palmyra leaves *or lontar*. These leaves grow on tall palms which can grow up to 30 meters high. The leaves are fan-shaped and up to two to three meters in length. Most *lontar* handicraft-makers make custom-ordered products, which include tissue holders, pot-plant holders, and purses.[7]

Du'Anyam, is taking an active role in engaging around 400[8] female basket weavers across 11 villages in the East Flores district. Their weaving center in Wulublolong Village, Solor Island, East Flores, called *Rumah Anyam* has been the centre of Du'Anyam's product development.

There are around 24 weavers working in *Rumah Anyam,* and these basket weavers can process up to 2,000 palmyra leaves per month, resulting in approximately 30,000 trimmed leaf strips, which are

[3] Indonesian Trade Research and Development Agency
[4] TrendEconomy
[5] Decent Work for Food Security and Sustainable Rural Development in Nusa Tenggara Timur, Indonesia 2015 - 2018, Ministry of Village, Disadvantaged Areas Development and Transmigration. Retrieved from: http://setjen.kemendesa.go.id/assets/files/ProDoc_DW4FS_NTT_updated_May_28,_2015_(final).pdf
[6] Indonesian Agency for Agricultural Research and Development
[7] *Ibid.*
[8] From Zero to 500 Weavers. Retrieved from: https://www.duanyam.com/2018/12/20/from-zero-to-500-weavers/

sized five to 10 millimeters in width.[9] With these processed leaf strips, Du'Anyam's basket weavers can produce around 1,000 - 1,500 finished products per month with retail prices ranging between IDR25,000 (~US$1.75) and IDR295,000 (~US$22.10) depending on the size and design.

Most of Du'Anyam's products are sold to individuals and companies, such as hotels, in Indonesia, but they are also exported to Korea, Japan, Australia and the US. In 2018, Du'Anyam were selected to produce souvenirs for the Asian Games.[10] Maintaining high product quality is Du'Anyam's major objective to secure a broader market.

Du'Anyam's challenge is the inefficient and time-consuming process of cutting palmyra leaves into strips. The traditional method is to use a simple knife resulting in inconsistency in the width of the strips, which leads to the production of lower quality products and high levels of waste.

The current trend indicates that the demand for basketware will continue to increase in the global market as the preference for home decor and fashion accessories made from "eco-friendly" materials is growing. In order to compete globally and to continue to attract buyers, basketware weavers in Indonesia will need to improve on their creativity and quality.

With the palmyra leaf cutter, we aimed to improve the process of cutting the palmyra leaves, making the process more efficient and the leaves more consistent than those produced with the tools currently used.

HYPOTHESIS

We hypothesized that the palmyra leaf cutter will enable weavers to produce better weaving materials - creating leaf strips with a more consistent width and creating more strips than with the current tools in the same period of time.

METHODOLOGY

Kopernik rapidly tests innovative solutions in order to determine their potential to reduce poverty effectively. In these experiments Kopernik adopts a lean approach, collecting and analysing small-scale data to determine whether the solutions show promise.

In this experiment, we tested the functionality and usability of a prototype palmyra leaf cutter. We worked directly with our partner in Wulublolong Village, Du'Anyam, to measure the following metrics and compare the results between the palmyra leaf cutter and the knife method:

- The consistency of the width of the leaf strips; and
- The quantity of leaves cut in a particular time frame.

FINDINGS

[9] Data collected from Du'Anyam
[10] The Weaving Mothers for a Better Future

TECHNOLOGY PERFORMANCE

Together with Du'Anyam, Kopernik developed a cutting tool with the objective to increase the weavers productivity by cutting more leaf strips than the manual method and generating a more consistent width. From the discussion with our partner during which they explained their challenges, Kopernik developed the following ideas to build the prototype (Table 1).

Requirement	Reasoning	Solution
Produce strips with a consistent width (there are three strips size requirements: 5mm, 7.5mm, 10mm)	• A good woven product needs to meet the width requirements. • Consistent strips result in higher quality products that are more likely to meet the needs of the export market. • Meeting the width requirements consistently will reduce waste.	• Make the cutter plate from steel to ensure cutting stability and consistency. • Ensure the cutter has all three width sizes required by the partner. • Use steel-strengthened lanes to guide the cutting process.
Produce more strips than the current tools in the same period of time	• Our partner identified the inefficiency of the manual method and requested that more leaves could be cut at the same time. • Reduce the time needed to cut strips to increase production capacity	• The plate should have several lanes to cut multiple leaves at the same time. • By using a clamp, multiple leaves could be stacked and cut at the same time

Table 1. Leaf cutter design specification

Kopernik built the first prototype of the leaf cutter to address the challenges explained by Du'Anyam, however after one month of data collection, we learnt that the leaf cutter was generating fewer leaf strips than the manual knife method currently used (Figure 2). We compared the number of strips produced in an hour for two strip sizes, 5 mm and 7.5 mm, since these are the most commonly used sizes by the weavers. The leaf cutter generated 18 percent fewer 5mm strips and 64 percent fewer 7.5 mm strips than the manual knife method. The reasons for this included the fact that the new mechanism was slow for the weavers to learn, and the clamp that was originally intended to enable the stacking of several leaves on top of each other to cut multiple leaves at once and increase productivity was not strong enough.

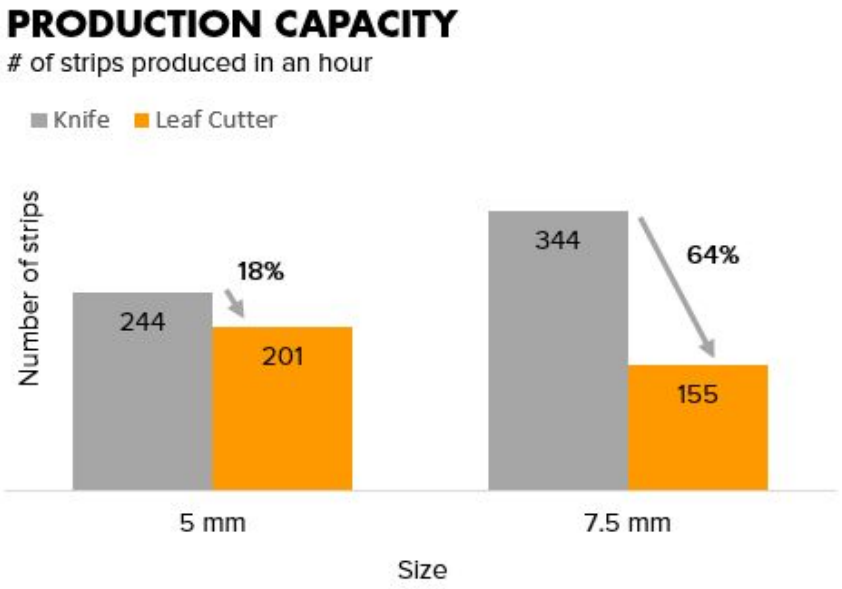


Figure 2. Comparison of number of strips produced in an hour

The leaf cutter also resulted in less consistency of leaf width, with 43 percent less consistent strip width. This was due to the leaf cutter design where the steel plate lanes were not accurately shaped during the laser cutting process and resulted in warping of the metal plate, which led to a reduction in width consistency. The weavers also found it difficult to place the knife of the leaf cutter in the lanes properly. These results therefore show that the first leaf cutter prototype did not perform better than the knife.

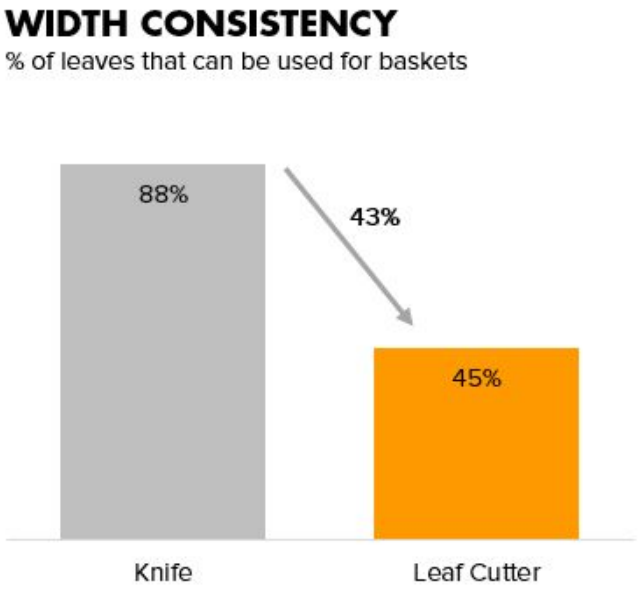


Figure 3. Comparison of percentage of leaves that can be used for weaving

USERS' EXPERIENCE

The current manual cutting process uses a small knife and sizing tool, called a *kenika,* that the weaver creates each time they cut the leaves (Figure 4). These tools are easy to find, easy to use and familiar for the weavers to handle, since they have been using them from the first time they

learned basket weaving. The challenge is that the process is not very efficient or accurate.

Figure 4. Kenika for 5 mm and 7.5mm strips

Despite the overall reduced production capacity and reduced consistency as compared to the knife, the experiment showed that production capacity increased over time as the weavers became more comfortable with using the leaf cutter. The weavers began with producing 123 strips on the first day to 277 strips on the tenth day (Figure 5).

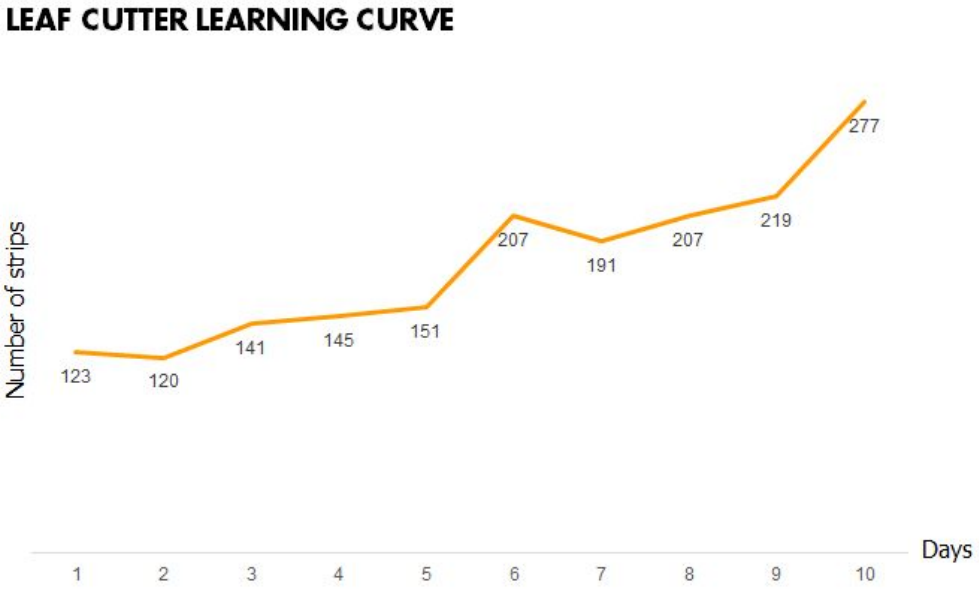


Figure 5. The weavers' learning curve using the leaf cutter

We observed that the weavers prepare the leaves in three stages (pre-cutting, cutting and weaving) using the manual method. However, with the leaf cutter, they included an additional stage of post-cutting to ensure better product quality (Figure 6). The post-cutting stage included discarding any strips that were not consistent, which then led to a higher quality finished product. We also observed that this post-cutting process was not taking place, meaning that all strips, whether they were consistent - perfectly cut to the right width - or not, were used to make the finished woven product. Because this post-cutting process does not occur this often leads to some products being rejected by export buyers. Du'Anyam told us that up to 40 percent of their finished products using the manual cutting method are rejected because of the inconsistency of the width of the leaves

which results in a product that does not meet the necessary quality standards[11]. We are unsure why the manual method does not involve the additional post-cutting step to remove the inconsistent leaves so that the weavers avoid such a high rejection level. This is something that we would need to investigate further if we were to move to a second phase for this project.

If the leaf cutter performed as intended, when using the leaf cutter, there could be two steps the weavers would do not have to undertake compared to the manual process, 1. preparing the *kenika*, and 2. cutting the second strip (multiple strips could be cut within one cut of the leaf cutter as the clamp (in theory) , could stack multiple leaves on top of each other so that several could be cut in one go). However, as we found during the testing process, the clamp was not effective as it was not strong enough to hold the stacked leaves in place, therefore this potential benefit of the leaf cutter was not in fact realised.

Method	Pre-Cutting		Cutting		Post-Cutting	Weaving
KNIFE	1 Separate the leaves' bones	2 Prepare *kenika*	3 Cut the first strip*	4 Cut the second strip	5 Select the strips for weaving	6 Weave strips into products
LEAF CUTTER	1 Separate the leaves' bones	2 Clamp the leaf** and set the knife	3 Cut into multiple strips		4 Select the strips for weaving	5 Weave strips into products

*One leaf can produce four 5mm strips. For the 7mm strips, three strips can be produced from one leaf. Only two strips are produced from one leaf for the 10mm width strips.
** We hypothesize that there could be a stack of strips placed in the leaf cutter for a one time cutting process, however, the weavers found that the clamp did not meet this requirement.

Figure 6. Palmyra leaf cutting process

Another disadvantage of the leaf cutter was the comfort level for the weavers. When using the manual method, the weavers sit on the floor and gather together to chat while producing the strips (Figure 6.1). However, only one or two weavers are able to work with the leaf cutter at a time and the tool required the weavers to stand and bend over the machine to cut the leaf. When two weavers use the machine, one sets up the clamp and knives and one weaver holds the end of the leaf (Figure 6.2).

Figure 6.1 A weaver sits using the manual method; 6.2 The weavers have to stand and bend over the machine to cut the leaf.

[11] Based on information on quality control from Du'Anyam

CONCLUSION

The results of this experiment showed that the first prototype of the palmyra leaf cutter, did not perform better than the manual method. The leaf cutter generated 18 percent less 5mm strips and 64 percent less 7.5 mm strips than the manual cutting tool during the period of data collection. The mechanism was slow for the weavers to use and the clamp that was originally intended to stack several leaves on top of each other to increase productivity was not strong enough. In terms of width consistency, the result was also fewer consistent strips for the leaf cutter - overall the strips were 43 percent less consistent due to the cutting plate lanes that were not accurately shaped and warping that occurred, which resulted in less consistency than expected.

However, the learning curve of cutter use did show promise, with the weavers more than doubling their production using the leaf cutter over a 10 day period. In addition, , the product development process, indicated that using the current manual method, if the weavers discarded all the strips that were not the correct width, this would likely reduce the number of finished products being rejected by export buyers and lead to a higher production capacity of higher quality products that meet the necessary quality standards.

TESTIMONIAL

"We see that the machine could potentially improve our processing method, but really it was too hard to operate and too big for us, it would be great if there's a simpler tool or machine that is better than the manual method but not as complicated as this. " - Koli Manuk, Du'Anyam's weaver

RECOMMENDATION

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

- Improve the prototype by conducting a follow up experiment;
- Increase quality control methods at the post-cutting stage to reduce the number of finished products that are rejected by export buyers.