

KOPERNIK PROJECT REPORT – EXPERIMENTATION PROJECTS

INCREASING FARMER FOOD SECURITY AND INCOMES: GRAIN STORAGE SOLUTIONS PHASE ONE

CONTEXT

This project was conducted in Likotuden, Kawalelo village, 35 km west of Larantuka, East Flores regency. Kawalelo is the driest village in Lewulema district, receiving less than 300mm of rainfall per year and relying solely on spring water. Furthermore, Likotuden has an extreme climate and rough terrain including high temperatures and rocky soil. Despite this harsh environment, the majority of villagers still work as farmers because they have limited options for producing food and generating an income.

Sorghum, a type of cereal grain, is a suitable crop for the environment of Likotuden. Sorghum doesn't need much water and is able to grow in extremely high temperatures. Local farmers grow sorghum from December to February, and the harvest season takes place from May to July. Farmers use the harvested crops for daily consumption, to feed their livestock, and if anything is left over, they sell it to earn additional income.

LOCATION

PROJECT LOCATION: LIKOTUDEN, EAST NUSA TENGGARA



HYPOTHESIS

Hermetic plastic bags and hermetically sealed plastic drums will:

- a) reduce the number of weevils as compared to the traditional storage methods minimising crop infestation and crop losses;
- b) reduce the impact of rodents as compared to the traditional storage methods minimising crop losses;
- c) keep the grain stored at a stable moisture level to prevent mold growth and aflatoxin

contamination.

METHODOLOGY

Kopernik rapidly tests innovative solutions in last mile contexts in order to determine their potential to reduce poverty effectively. In our experiments we adopt a lean approach, collecting and analysing small-scale data to learn the effectiveness of the solutions.

In this project, we tested three methods of storage, each using 50kg of sorghum:

1. A traditional woven plastic sack
2. A hermetic plastic bag placed inside the traditional woven plastic sack; and
3. A hermetically sealed plastic drum.

Each container was kept in a *lumbung*, a traditional warehouse used by farmers to store their crops, for six months at an ambient temperature. Every month, each container was opened and three cans of sorghum were taken out as a sample (~600gr). We then measured the following indicators:

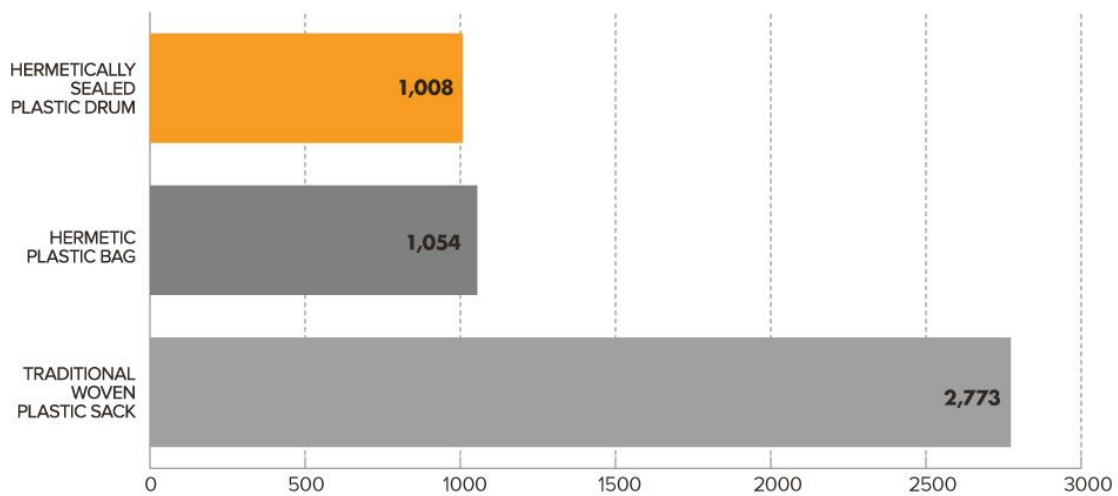
1. Number of weevils, alive;
2. Number of weevils, dead;
3. Moisture level.

FINDINGS

After six months, we found that:

- the hermetic plastic bag and the hermetically sealed plastic drum had a significantly lower number of weevils when compared to the traditional storage method; and
- there was no significant difference in the number of weevils between the hermetic plastic bag and the hermetically sealed plastic drum.

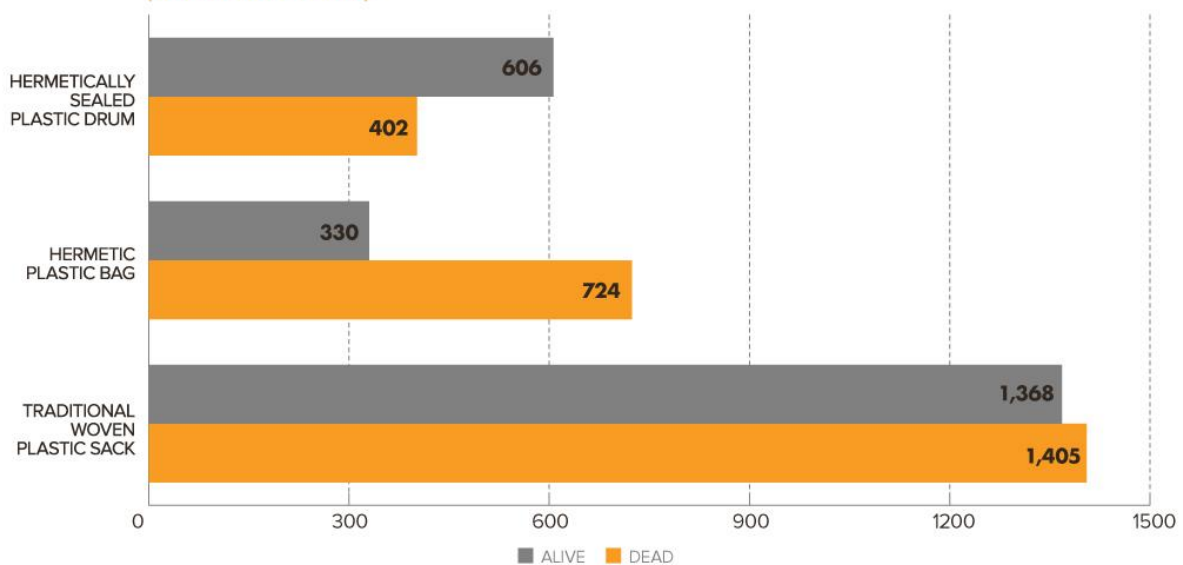
TOTAL NUMBER OF WEEVILS



Upon breaking down the number of weevils into two groups, alive and dead, we learned that:

- both the number of dead and alive weevils found in the hermetic plastic bag and the hermetically sealed plastic drum were significantly lower than the traditional storage method;
- the number of dead weevils found in the hermetic plastic bag were nearly twice the amount found in the hermetically sealed plastic drum, leading us to consider whether the hermetic plastic bag is more effective in eliminating the oxygen available to weevils.

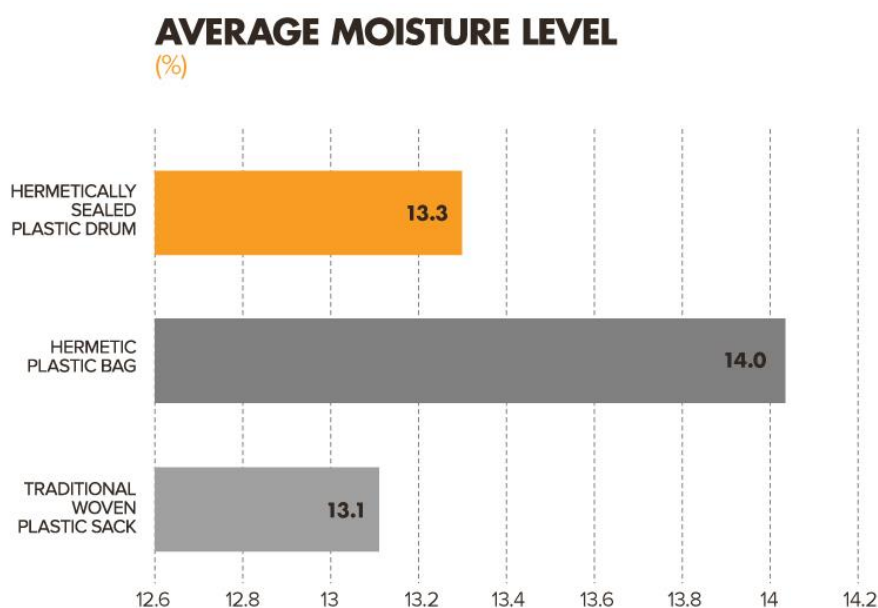
TOTAL NUMBER OF WEEVILS (DEAD AND ALIVE)



Upon observation of the hermetic plastic bag and the hermetically sealed plastic drum, there was no evidence of rodents breaching the storage containers. For the traditional plastic woven sack however, there was some evidence of rodent activity with holes in the sack which could have resulted in crop losses beyond weevil infestation.

The moisture level was also measured during the six-month experiment. The moisture level is important as sorghum is susceptible to aflatoxin, a naturally occurring toxin produced by certain fungi. If aflatoxin-contaminated crops are consumed by humans, aflatoxin poisoning can occur.

The Food and Agricultural Organisation (FAO)¹ recommends that sorghum grains' moisture level should not exceed 14.5% for direct human consumption.



The graph above shows that all storage methods maintained an average moisture level under 14.5% with the hermetic plastic bag performing slightly worse than the plastic drum or traditional plastic woven bag.

CONCLUSION

Our assessment concluded that the most effective solution of the three was the hermetic plastic bag. While it did not have the lowest moisture level, the level was within the 14.5% limit and it had the lowest number of weevils and remained free from rodent breaches. It is also more affordable when compared to the plastic drums. The hermetic plastic bag with a capacity of 60kg costs IDR27,500 (~US\$2) and the hermetically sealed plastic drum with a capacity of three times as much sorghum at 180kg cost IDR 350,000 (~US\$26). The traditional

¹FAO, *Sorghum: Post Harvest Operations*, the Codex Alimentarius Commission has established global standards for sorghum grains under Codex Standard 172-1989.

woven sack with a capacity of 60kg costs IDR5,000 (~US\$0.35).



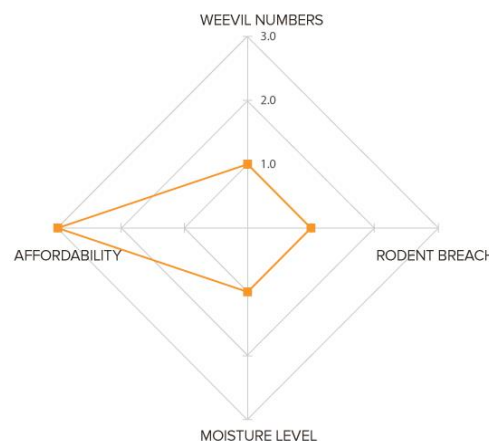
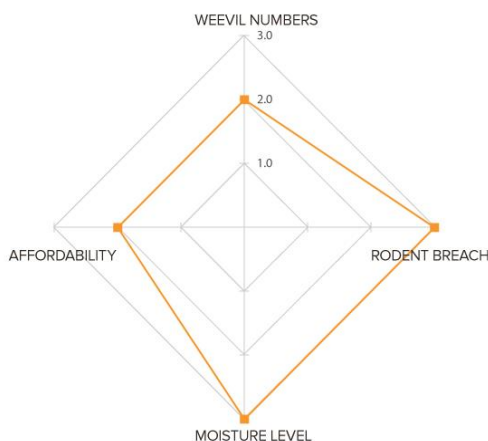
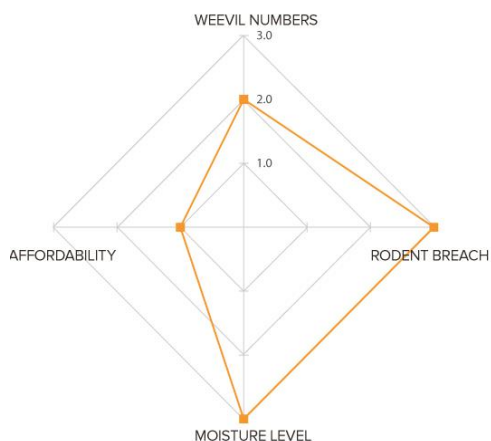
HERMETICALLY SEALED PLASTIC DRUM



HERMETIC PLASTIC BAG



TRADITIONAL WOVEN PLASTIC SACK



Please Note: A rating of three is the best result. The rating is based on - Weevil Numbers: <1000 = 3, 1,000-2,000 = 2, >2,000 = 1, Rodent: 0 breaches = 3, Any breach = 1 (binary → there's no scenario for scoring 2), Moisture Level: <13.5 = 3, 13.5-14.5 = 2, >14.5 = 1, Affordability: <\$1 = 3, \$1.00-\$10 = 2, >\$10 = 1

TESTIMONIAL :

"I like the airtight drum because it has a pretty tight cap which can potentially prevent air leakage. Furthermore, it can store more than 40kg which allows us to secure more sorghum from weevils for a longer period of time, as compared to the traditional woven bag."

- Jeremiah Letor, Sorghum Farmer, Likotuden

RECOMMENDATION

Based on the data collected, we recommend that:

1. Kopernik conducts another round of tests to determine whether a better result can be obtained if the storage containers are filled to capacity and not opened each month.



A phase two experiment will be implemented by Kopernik. In this experiment, each storage container will be filled with sorghum to full capacity and will be sealed and unopened for a period of six months. The same data as in phase one will be collected and compared. In phase two, Kopernik will also weigh the sorghum at a baseline level and at the end of the six-month period to determine the amount of crop loss.

LEARN MORE

Kopernik's CEO, Toshi Nakamura, recently published a [Kopernik Insight](#), concluding that the hermetic storage solutions can reduce weevil contamination by up to two thirds.