

**Dehusking Rice with a Leather Insert in a Molino**  
D-Lab: Energy Final Report

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## ABSTRACT

ASAPROSAR is currently introducing rice cultivation in the communities of La Magdalena district of El Salvador both as a source of nutrition and income. Since current methods for processing rice are both time and money intensive, we worked to develop a cheap and local alternative method. After preliminary research and brainstorming, we focused on modifying a Victoria Mill molino by inserting a different material which husks rice grains without crushing them. We tested several different materials and varied the spacing between the molino plates and insert, concluding that leather is the most appropriate insert. Through an extensive experimentation and optimization, we developed a 12-step process of husking that is cheap and durable.

## PROBLEM STATEMENT

Currently, processing rice is expensive and time consuming due to high costs of transportation and price of dehusking at the milling factories. It costs \$5.50 for 25 pounds of rice (\$3 of which is due to transportation). The roundtrip to the mill can take a full day (up to six hours on the bus alone) and cost more than a day's salary (\$4), making the process inefficient. The process needs to be local, cheap, quick, and durable to allow for communities to process rice.

## DESIGN SPECIFICATIONS

In order to introduce a new process in the La Magdalena area, our team sought to develop a methodology that is efficient, timely, gentle, safe, affordable, assemblable, durable, and beautiful. The product specifications for our product are found in Table 1 below.

**Table 1.** Product specifications for rice dehusking method to be recommended to ASAPROSAR for use in Santa Ana, El Salvador.

Attribute	Metric	Unit	Value
Efficiency	Amount of rice successfully dehusked	%	>90
Timely	Throughput	lbs/min	1/3
Gentle	Amount of rice crushed / cut in half	%	<10
Safe	Hazardous residue	binary	No
Affordable	Cost	\$	2
Assemblable	Speed of assembly	minute	3
Durable	Lifetime of insert	lbs. of rice	200
Beautiful	Aesthetically acceptable	Binary	Yes

### ***Efficient***

Processing rice in any way takes effort and the new method should make the most efficient use of the human power input. Efficient rice processing should remove husks from at least 90% of the rice grains. The output from processing at the mill still contains some husked rice, so our process should be equivalent or better than the mill efficiency to make a user's power input worthwhile.

### ***Timely***

While processing at the mill takes up to a day with transportation and processing, processing the rice in the community should not be time consuming. It is essential that community members are not discouraged from processing their own rice because of time concerns. A typical family in the La Magdalena area goes through 1 to 4 pounds of rice a week, depending upon income -- we required the throughput of rice to be 1 pound to 3 minutes or less. This is certainly an improvement over a day's trip to a processing mill.

### ***Gentle***

Dehusking rice has the hidden intricacy of being rough enough to remove the husk yet gentle enough to not crack or break the rice. Previous models had cracked or crushed the rice grains to the point where eating them would not be acceptable and would be a waste of the grown rice in the community. We desire to have the amount of rice crushed or cut in half to be less than 10% of the total processed rice. Processing at the mill does produce crushed rice as well, so our process should be equivalent or similar to the ratio from the mill.

### ***Safe***

One of the main concerns with the previous prototype, a black piece of inner tube adhered to the grinding plate on the molino, is the residue that is left on the grains of rice. Families were concerned that the black color left on the rice was not healthy. Undoubtedly, it is essential for processing to not leave hazardous residue on the rice as the rice will be consumed by the families and/or sold to others for income.

### ***Affordable***

It is vital that the communities have the financial means to buy the technology. One of the reasons for introducing rice is to introduce an additional source of income. The project would be moot if the material we selected as an insert worked beautifully, but the community members were not able to afford it. Therefore, we wanted process selected to cost under \$2.

### ***Assemblable***

The dehusking product should be easily assembled so the community members would not be discouraged from using it. Our goal was to be able to put the product together in 3 minutes. Our ultimate goal is to provide an *easier* way to remove the rice husk; this requires a simple and quick assembly process.

### ***Durable***

We want our technology to last as long as possible so that families will spend less money and time to obtain a replacement. Our goal is for the insert to withstand 200 pounds of rice throughput. Since each family consumes 1-4 pounds of rice per week and there are about 10

families per home-group, or "casero", this lifetime would enable the insert to serve the community for roughly five or six weeks.

### ***Beautiful***

Although this specification is not as critical as some of others that were previously stated, we hope to make the dehusking product as aesthetically pleasing as possible. Experience has shown that individuals are more likely to choose a less effective aesthetically pleasing product over a more effective but less appealing product. We want to encourage the community members to use this product as much as possible and take pride in their rice dehuskers.

## **DESIGN CONCEPTS CONSIDERED**

In order to explore various methods for dehusking the rice, we brainstormed various concepts and ideas. We also researched some existing technologies, both simple and more technologically advanced, that communities in rice-growing regions have used over the years. The various methods settled upon were compared via a Pugh chart, seen in Table 2 below. The essential function of each design is to apply the necessary friction to the rice in order to remove the husks. The following sketches reveal the ideas.

### ***Mortar and Pestle***

The mortar and pestle method is one of the most common and basic methods for dehusking rice in developing countries. A forceful pound with a stick or rod is enough to remove the husk. Our diagram resembles the traditional mortar and pestle concept, with a stone bowl and wooden stick. This method is technically simple and very cheap, but also energy intensive. Additionally, only small amounts of rice can be processed at a time.

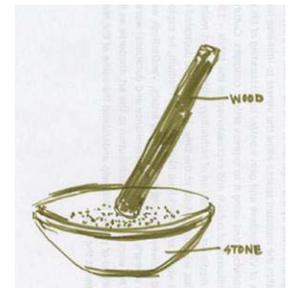


Figure 1.

### ***Plates rubbed together***

This method dehusks rice by placing the rice between a layer of chicken wire and of wood which are moved back and forth. The motion would provide enough friction to remove the husks. This is similar to the concept of the molino that has been experimented with in the communities of La Magdalena (see below). The motion should be enough to pull the husks off the rice. This concept is promising, but we were concerned about the price of materials; wood is very expensive and chicken wire is both expensive and hard to acquire. The process should work well and the system is easy to assemble.

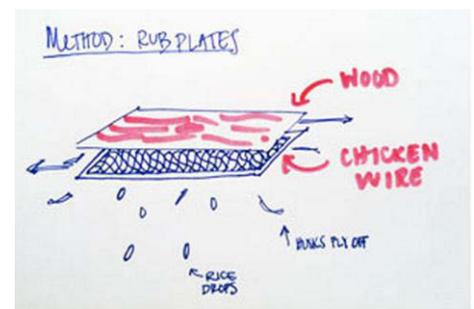


Figure 2.

### ***Pepper Grinder***

This idea was inspired by a pepper grinder. It consists of using a cylinder shell and a shaft with a handle. Rice is poured into the shell and the shaft is inserted. The shaft is then turned. The shell and the shaft both have a rough surface to create friction and catch the rice husk. One limitation is the fact that only a small amount of rice is able to be dehusked at a time. The construction does not require complicated or expensive mechanisms.

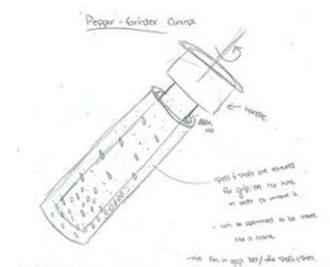


Figure 3.

### ***Victoria Grain Mill (Molino)***

This is a mill that is currently used introduced in La Magdalena region as a corn grinder by ASAPROSAR. Amy Smith had the idea of adding a rubber insert between the metal plates of the molino. Although a rubber insert may not be the best insert, the concept of modifying the molino by incorporating an insert struck us as an idea with strong potential. The molinos are readily available for \$20 in the markets of Santa Ana. They require little assembly and are considerably durable. Additionally, the molino could continue to be used for milling other foods, such as yucca and corn. The molino has the added bonus of being easy to use and capable of processing a large amount of rice at one time. The only draw back would be the initial \$20 cost as well as the ASAPROSAR-dependent availability and price of the material insert.



**Figure 4.**

**Table 2.** Pugh chart delineating dehusking methods

	<b>Pepper Crusher</b>	<b>Flat Plates (Back/Forth)</b>	<b>Mortar &amp; Pestle</b>	<b>Molino Plates (Around)</b>
<b>Efficiency</b>	S	-	-	S
<b>Ease of Fabrication</b>	-	-	+	S
<b>Physical Labor</b>	S	-	-	S
<b>Cost</b>	+	-	+	S
<b>Durability</b>	-	-	+	S
<b>Alternative Uses</b>	-	-	S	S
<b>Possible for our team</b>	-	S	-	S

### ***Design Decision***

Ultimately, it was most feasible and efficient to adapt the molino and create a process for the dehusking. The molino is locally available in marketplaces in El Salvador and is already being distributed in the communities by ASAPROSAR. It is most economically feasible to make use of the already present equipment, as materials like metal and wood are expensive for initial costs of the product. It is possible to maintain the molino’s original purpose, allowing for a multi-purpose initial investment. The construction of the molino is very durable and allows for a long lifetime for the product. Finally, with the short timespan of our project, it would be most efficient to be able to have a working deliverable to send to ASAPROSAR as opposed to an inefficient prototype. Therefore, we chose to pursue the adaptation of the molino with the material insert as our design.

## INITIAL EXPERIMENTATION

Windmill Rice in Arkansas donated a 50 kg bag of whole rice to the project. This rice was used for all testing; it was similar in size and texture to the rice brought back from El Salvador. The first goal was to choose a material to place between the molino plates. Table 3 shows a Pugh chart comparing all materials initially considered, whether experimented with or not.

**Table 3.** Pugh chart comparing materials to use as an insert to molino

	<b>Leather</b>	<b>Rubber</b>	<b>Metal</b>	<b>Wood</b>	<b>Fabric</b>
<b>Cost</b>	+	S	+	-	+
<b>Residue</b>	+	S	S	+	S
<b>Durability</b>	-	S	+	-	-
<b>Availability</b>	S	S	S	-	+

The following materials were tested:

- 1 piece of leather
  - untied and allowed to rotate
  - tied onto the plate attached to the shaft to prevent relative rotation
  - tied onto the plate attached to the shaft to prevent relative rotation, with a 2-mm thick craft foam behind the leather to provide cushion
- 2 pieces of leather hot-glued together
  - untied and allowed to rotate (hot glue was only for prototyping purposes and failed after a few rounds)
- 1 piece of 5-mm thick honeycomb pattern polyurethane rubber
  - tied onto the plate attached to the shaft to prevent relative rotation
  - untied and allowed to rotate
- 1 piece of 5-mm thick flat side of the honeycomb pattern polyurethane rubber
  - untied and allowed to rotate
- Flat piece of the body of the molino

The leather and rubber were purchased in a shoe store near the ASAPROSAR headquarters in Santa Ana.

With each of the materials tested, we varied the number of turns of the main knob from all the way tight, varying the loosening from 2 turns to 6 turns. By varying the number of turns, we controlled the spacing between the insert and the molino plates. Both the materials and number of turns were not systematically tested, but rather combined variably to get a good intuition behind how the rice was being treated and to expedite initial experimentation. Each test ran 50 g of rice through the molino to quickly gauge which was the most promising combination of material and number of turns. We winnowed each of the tests. With the most promising results, we proceeded to manually separate the whole rice, the dehusked rice, the broken rice, and the powdery rest. Each element of the processed rice was weighed to find which had the greatest ratio of dehusked rice to whole and broken rice. Those measurements are seen in **Table 4.** below.

**Table 4.** Results of initial experimentation

Material	Tightness	Mass (all)	Mass (w/ husks)	Mass (broken)	Mass (Whole)
Rubber (Honeycomb side)	2.25 turns	50 g	1 g	15 g	14 g
Rubber (Honeycomb side)	2.5 turns	50 g	9 g	11 g	13 g
Rubber (Flat side)	2.5 turns	50 g	1 g	14 g	12 g

Through these tests we learned three things:

- Dehusking results are similar across materials
- The number of turns (space between plates) is the biggest contributor to dehusking performance
- Softer materials reduce the amount of rice broken while dehusking

## **MATERIAL SELECTION**

After our initial material selection experimentation, it was found that dehusking results were very similar across the different materials and overall, softer materials worked best. We decided to pursue leather, as it was cheap, durable, and available locally in El Salvador. We found leather that was unattached to the molino produced similar results as if it were attached. This allows the molino to be flexible for other uses in the community, like making cornmeal or grinding yucca, as the insert can be easily removed and inserted. In addition, without needing a hazardous adhesive or intensive sewing process, the insert will be less hazardous and less costly to attach.

Although we tested leather with multiple layers, we found that one layer seemed to produce similar results as two or more pieces. One layer wore and stretched a similar amount as two layers, so we expected one layer to be as durable. In terms of feasibility, one layer of leather is more optimal for our community. One layer of leather (cut to fit the molino) will cost a user about \$.50, whereas two layers would cost \$1.00 plus the cost of adhesive. The best method to attach the two pieces of leather together was using a rubber cement glue, which is costly and potentially hazardous.

One concern our group had surrounding the leather insert was its level of toxicity, and if it could potentially leave hazardous residue on the rice. One of the most toxic chemicals found in leather from the tanning process is Chromium. The Agency for Toxic Substances and Disease puts a limit of 100 µg chromium/L water on consumed products.<sup>1</sup> We found this to be equal to **eating** 7 of our leather inserts a day and concluded that any residue left on the rice would not be enough to contaminate it. In all, it made the most sense to progress with our optimization using leather, specifically targeting using a single piece.

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<sup>1</sup> Yu M.D., Dianyi. "Chromium Toxicity". WB 146, Agency for Toxic Substances and Disease Registry, Online <http://www.atsdr.cdc.gov/csem/chromium/docs/chromium.pdf>, Accessed 3 May 2011. page 13.

## PROCESS OPTIMIZATION

In order to optimize our final process, we conducted a series of larger volume experiments, processing about 850 grams of rice per test for a grand total of 15 kg processed throughout this optimization. We tested rubber and various leather inserts, reported in Table 5 below. For each insert, we conducted an experiment with a tightness of 4.5 turns and a tightness of 5 turns. The results of our experiments are also listed in Table 5. In addition to the number of turns, we noted the amount of the rice left after winnowing, the amount rice and husks that were crushed beyond use, the processing rate (in pounds per minute) and the percent of rice that was successfully dehusked.

**Table 5.** Process optimization results. Experiments 5 and 6 show the results of the selected material. Experiment 3 with the rubber failed because it stretched too much, disallowing its analysis.

#	Material	Turns	Original weight (g)	Post-winnow (g)	Broken (g)	Throughput (lb/min)	% dehusked
1	Leather (2pc)	4.5	848 g	518 g	58 g	0.405	96%
2	Leather (2pc)	5	866 g	546 g	61 g	0.576	94%
2*	Leather (2pc) (Processed 2x)	5	225 g	214 g	9 g	0.295	96%
3	Rubber (1pc)	4.5	860 g	--	--	--	--
4	Leather (2pc)	4.75	854 g	572 g	50 g	0.344	94%
<b>5</b>	<b>Leather (1pc)</b>	<b>4.5</b>	<b>851 g</b>	<b>570 g</b>	<b>48 g</b>	<b>0.478</b>	<b>94%</b>
<b>6</b>	<b>Leather (1pc)</b>	<b>5</b>	<b>847 g</b>	<b>412 g</b>	<b>64 g</b>	<b>0.44</b>	<b>96%</b>
7	Leather (2 pc glued)	4.5	856 g	507 g	68 g	0.54	98%
8	Leather (2 pc glued)	5	849 g	486 g	84 g	0.442	96%

By processing a larger quantity of rice, we were able to eliminate rubber from the list of potential materials. The force of 850 g of rice caused the rubber to stretch significantly, up and over the edge of the molino plates. The whole rice passed through the molino unprocessed and the rubber jammed in the plates so the handle could not be turned.

Determining the percent of rice that was successfully dehusked in a time-efficient manner required some problem solving, as we did not want to manually separate almost a kg of rice. Instead, we took a 50-g sample of each experiment, separated the whole rice from the dehusked rice in that small sample, and weighed the amount of whole rice. In order to confirm that this was an accurate sampling, we separated all 850 g of the rice from the experiment 1 (two leather pieces, 4.5 turns) and measured how many grams of rice were still whole compared to the entire amount of processed rice. Then, we compared that ratio to the ratio found from the 50-g sample of the same experiment; the two efficiencies were the same. Therefore, we knew we could use a 50-gram sample to determine the percent of dehusked rice for the rest of the experiments.

In the process of using the sieves to separate the completely crushed rice and husks, we discovered that the rice that was still whole collected at the top of the sifter as we shook the sieves back and forth. We were able to easily scoop out most of the whole rice. In this manner,

we were able to increase the efficiency of our process. In one instance, we took the experiment with the worst efficiency (5 out of 50 grams of rice still whole) and used the shaking method to separate the whole rice. After scooping out the whole rice, we discovered that only 3 out of 50 grams of rice were now still whole. The shaking method allowed us to increase the efficiency from 90% to 94%.

We conducted various experiments regarding the shaking method to determine what was required to make the shaking method consistently work. We used various types of containers with varying amounts of rice in the container. We found that the best container had a flat bottom with rigid sides. The ratio of rice depth to the container diameter was 1:20. That is, the rice is relatively shallow in the container.

As a result of our eight experiments, we concluded that the optimal material insert would be a single piece of leather. We noticed that all the processes yielded about the same amount of post-winnowed rice and had roughly the same efficiency. Since there was negligible difference between using two or one piece of leather, we decided that one piece was the better insert since it is cheaper. Additionally, we would not have to worry about the potential toxicity of the glue connecting the two leather pieces.

We additionally concluded that the optimal number of turns was between 4.5 and 5. Five turns yielded some more whole rice, and four and a half turns yielded more broken rice. Ultimately, it is the decision of the communities to decide which they prefer. They must determine their optimal dehusking process by their own experience. We were tentative to make the process more specific for fear that our process would not work exactly for the other molinos distributed by ASAPROSAR.

## DESCRIPTION OF PROCESS DESIGNED

The process developed includes simple steps, including gathering a piece of leather and 10 washers. Figure 5. shows the 12 step program we will propose to ASAPROSAR.

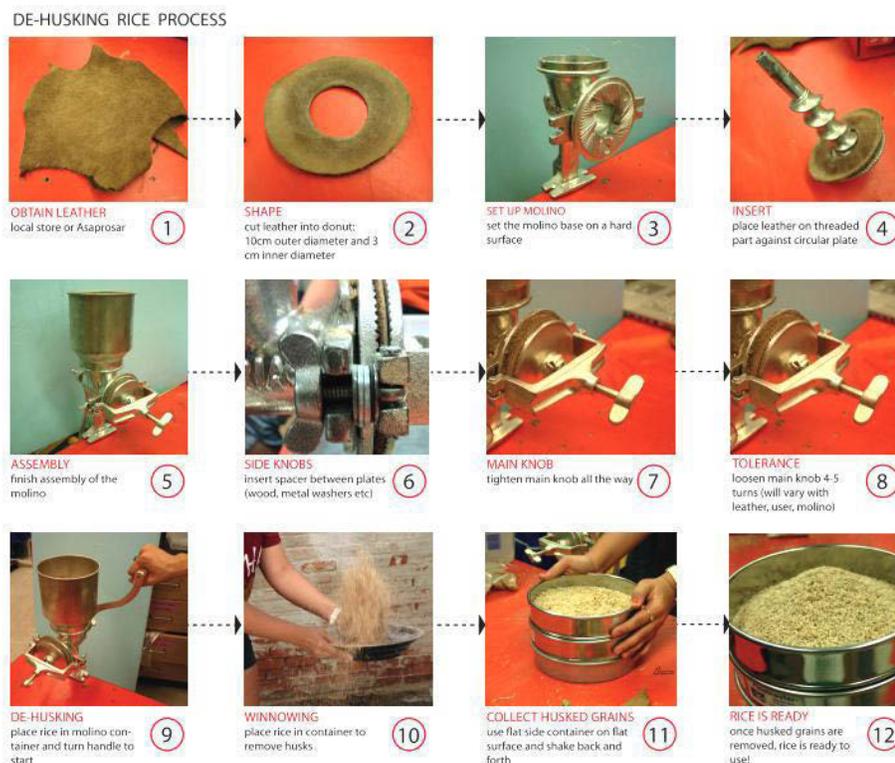


Figure 5. The 12 step de-husking process proposed

## **12-step rice dehusking process using a leather insert in a Victoria mill**

1. Leather can be obtained at the local shoe store or supplied from ASAPROSAR.
2. The shape was easily cut using metal snips, though any scissors would suffice. The leather is there to cover the entire surface of the molino plates, so was 10-cm diameter with a 3-cm hole in the center for our work with the Victoria molino.
3. The molino has a screw on the bottom in order to clamp around a horizontal surface such as a table. The setup of the molino may be made more permanent by also bolting the molino onto a stand through the two tabs on the side.
4. All parts are ready and the assembly process begins. Place the insert onto the threaded shaft. The insert may have to be “screwed” onto the shaft if it is a bit tight. The hole does not have to fit exactly around the base of the shaft; within reason, the insert may shift around if the hole is larger or become warped if the hole is smaller.
5. Finish the assembly by attaching the grain reservoir and securing the handle with the tabbed screw.
6. Add about five (5) standard washers to each of the threaded “screws” on the C-brace. One can add any spacer that is available, as long as it provides about 1 cm (or a bit less than the width of a finger) more space between the body of the molino and the C-brace. These spacers cause the metal mill plates to be separated even when the side knobs on the C-brace are tightened all the way. If these spacers are not there, the C-brace may fall off while processing.
7. Tighten the main knob in all the way to get no space between the insert and metal mill plates.
8. Increase the spacing between the plates by loosening the main knob 4-5 turns. Loose spacing (5 turns) will give more grains with the husk still on and fewer broken grains, while tight spacing (4 turns) will give more broken grains and fewer grains with the husk.
9. Add the rice to the molino and turn the handle to process all the rice.
10. Winnow the rice to remove husks.
11. Gently shake the rice back and forth in a shallow container for about twenty (20) seconds and you will notice that many of the rice grains with the husk still on it will surface to the top. Scoop out these grains and place them aside to run them through the mill again or to store for later. Continue to shake the container back and forth again in twenty (20) second intervals to remove most of the rice with husks.
12. The rice is processed.

## DISCUSSION

Overall, we are proud of our final design. It worked very well and met nearly all of our project specifications. Where it did fall short, it was by a small amount.

**Table 6.** The process's fulfillment of the product specifications. Shaded boxes indicate the places of improvement.

ATTRIBUTE	METRIC	UNIT	DESIRED VALUE	ACTUAL (4.5 turns)	ACTUAL (5 turns)
<b>Efficiency</b>	Amount of rice successfully dehusked	%	>90	94	96
<b>Timely</b>	Throughput	Lbs/min	1/3	.478	.44
<b>Gentle</b>	Amount of rice crushed or cut in half	%	<10	8.4	15.5
<b>Safe</b>	Hazardous residue	Binary	No	No	No
<b>Affordable</b>	Cost	\$	2	0.50	0.50
<b>Assemblable</b>	Speed of assembly	Min.	3:00	2:01 min	2:01 min
<b>Durable</b>	Lifetime of insert	Lbs. rice	200	160 lb. +	160 lb. +
<b>Beautiful</b>	Aesthetically acceptable	Binary	Yes	Yes	Yes

Our first project specification was efficiency. We wanted at least ninety percent of the husks to be removed from the rice. Our final system was 94-96% efficient.

Our second project specification was throughput, or how fast the rice could be processed. Our goal was to be able to process one pound of rice in three minutes. We were able to process about 850g (1.87 pounds) of rice in roughly 3.5 minutes. This corresponds to a rate of over 1.5 pounds of rice in three minutes.

Our third project specification was gentleness. We wanted less than ten percent of the rice to be broken. About one third of the rice was broken in our final design. Although we surpassed our targeted percentage, we are aware that the rice that is processed at the mill in El Salvador has a percentage of crushed rice as well. Moreover, since broken rice may still be eaten, we do not believe that this shortcoming will prevent the communities of La Magdalena from using our prototype. In order to address this shortcoming, we could attempt to further optimize the number of turns. However, the tightness may vary with each molino. We discovered that a large part of the efficiency is ‘getting the feel’ for the molino. Ultimately, the community must decide what ratio of whole rice to dehusked rice to crushed rice is appropriate. We do not want to be too specific with our instructions in case it does not work optimally in the community. We might consider optimizing the cranking method. Perhaps it would prove beneficial to turn the handle slower or turn it twice forwards and once back.

Our fourth project specification was safety. We wanted to make sure that if the material insert left residue on the rice, it would not be toxic. Concerns arose regarding the tanning process for the leather, but upon careful analysis, we determined that a community member would have to

eat seven leather inserts per day to suffer from the toxicity. Additionally, we processed a considerable amount of rice on one leather insert without much observed wear. There was no change in mass. Therefore, we concluded that not only would the residue left on the rice be safe, but there was very little residue left on the rice in the first place. We successfully met this project specification.

Our fifth project specification was affordability. Our aim was to have the cost be less than \$2. Leather costs \$4 per square foot. This corresponds to a price of about \$0.50 per insert, which is four times less than our specified price.

Our sixth project specification was speed of assembly. We wanted the product to be assembled in three minutes. It takes about a minute to replace the material insert once the molino is completely set up. To set up the molino from scratch takes about three minutes. Mostly likely, the molino will be left set up in the communities, which we observed when we visited over spring break. Thus, the overall assembly time is about a minute.

Our sixth project specification was durability. Our goal was to have the insert last long enough for 200 pounds of rice to be processed. We did not have 200 pounds of rice to test this specification. However, we processed over 7.5 kilograms of rice (16.5 pounds) with little visible wear on the insert. From this, we predicted that the insert should be able to process at least 160 pounds of rice, or the equivalent of a community's monthly consumption of rice. We do not know if the insert will last 200 pounds of rice. In order to determine if the insert lasts as long as we predict, we would have to process about 200 pounds of rice and observe how it fares (this would necessitate another generous contribution from Will Floyd of two more 50kg rice bags). If the leather fails significantly earlier than expected, we could test with other types of leather and continue to explore other materials if it proves to be a serious problem. However, based on our observations, we believe that the leather will endure a large quantity of rice.

Our last project specification was beauty. We wanted the design to be aesthetically pleasing to encourage its use. Since our design concept incorporates the molino, which the community already uses, we concluded that the final product was aesthetically pleasing. The molino is clean in structure and appearance and the leather insert is fine.

## **COMMUNITY PARTNER**

ASAPROSAR is a human development NGO based in Santa Ana, El Salvador. It works in rural areas to improve the quality of life by providing environmental and nutrition education, micro-credit opportunities, and general community development work. The organization is interested in helping communities while making them aware of environmental issues and teaching them the importance of respecting the surrounding natural world. Some of the issues that ASAPROSAR is addressing involve cooking with charcoal to reduce smoke, disposing of waste in particular areas to avoid contaminating soil and water, and harvesting sugar canes without setting fires.

While ASAPROSAR was interested in the development of many projects (lighting conditions, charcoal stoves, ventilation), they also expressed interest in a rice dehusking project. On one of our visits to the community of La Magdalena, we were introduced to families who were currently growing rice and were looking for ways to dehusk it more conveniently. Currently, one member of the family needs to take a 6-hour round trip bus ride to the nearest mill which costs \$3.00 and pay an additional \$2.50 for processing 25 lbs of rice. The trip is very time and money intensive and the amount of rice lasts for one month per family on average. ASAPROSAR is really

interested in helping with a dehusking method as it would greatly contribute to the rice cultivation project they have been trying to implement in the communities. The project will allow many families to improve their nutrition and hopefully generate income by selling the rice. ASAPROSAR have been really helpful with answering our numerous questions about the rice they grow, the advantages and challenges they have with it and general community needs. Included at the end of this section is a copy of our correspondence with them.

In order to ensure that our product design reaches ASAPROSAR, we will be in touch with Juan Carlos. Since it is sometimes difficult to communicate electronically with international community partners, we are going to mail a package to ASAPROSAR as well. The package will include the detailed instructions (with images) for assembling and using the molino in addition to the actual leather insert pieces. We will send an old and a new piece to demonstrate the expected level of ware. We are hoping that by mailing the prototypes and instruction manuals, we will facilitate the implementation of the project in a timelier manner. We will encourage Juan Carlos and Elena to keep us informed of the project along with the successes and challenges that the community members are dealing with. Although none of us are planning on traveling to El Salvador in the near future, we are hoping that the package we mail and the report we send will be sufficient for ASAPROSAR to take the project and introduce it to the communities they are working with. The simplicity of the product will make it easy for people to learn and use it fairly quickly. In any case, we will encourage ASAPROSAR to contact Yuliya if any further questions arise and Juan Carlos has her contact information. If the communities notice any challenges with the product, we can introduce the project for further optimization in future D-Lab classes.

Questions(in English):

1. What type of rice is grown in El Salvador?  
cebada and livalal
2. When is the planting and the harvesting season?  
May – November
3. When is the planting and harvesting season for corn?  
November - July/August
4. Before cooking the rice, is it processed? Or is the husk just taken off?  
just husk is taken off
5. Is the rice washed before it is cooked?  
yes
6. How is it cooked? Steamed or boiled?  
boiled
7. How much rice does a family eat in a week?  
4 lbs per week (if there is money), as little as 1 lbs
8. How much rice can a family grow in one season?  
depending on the land they have, 25 lbs or more
9. Do they want to grow rice for food or to sell it? Or both?  
both
10. How much does it cost now to process rice – transportation to the mill and the payment at the mill?  
\$2.50 for processing + \$3.00 for transportation
11. How many people/families have a molino?  
10 families per community

12. Will the molino be used by each family or will there be one for the community?  
the whole community will use the molino
13. When taken to the mill, are some rice grains broken? Are there any husked ones?  
there are some broken ones and there are few husked ones
14. Is the leather treated with chemicals?  
yes it is

Questions (Español):

1. ¿Qué tipo de arroz se cultiva en El Salvador?  
Cebada y Livial
2. ¿Cuándo se siembra y cuando se cosecha maiz?  
Mayo – Noviembre
3. ¿Y el arroz?  
Noviembre - Julio, Agosto
4. ¿Antes de comer el arroz, se procesa mas que quitando la cascara?  
solo quitando la cascara
5. ¿Se lava el arroz antes de que se cocina?  
si
6. ¿Cómo se cocina? Al vapor o hervido?  
hervido
7. ¿Cuánto arroz se come una familia en una semana?  
4 libras si les pagan por semana pero si no es así 1 libra por semana
8. ¿Cuánto arroz se puede crecer por una familia en una temporada?  
depende del espacio que tengan algunos solo 25 libras otros mas
9. ¿Quieren cultivar arroz para comer o vender? O las dos cosas?  
las dos cosas
10. ¿Cuánto cuesta ahora para procesar el arroz - el transporte a la planta y el pago en la fábrica?  
\$2.50 por 25 libras mas transporte \$3.00
11. ¿Cuántas personas / familias tienen un molino?  
10 familias por caserío si no tienen pagan \$0.40 por cada 5 libras de maíz
12. ¿El molino sería utilizada por cada familia o habrá sola una para la comunidad?  
el de arroz sería utilizado por toda la comunidad

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