

# **Feasibility Study of Cascara Jelly Production in Negros, Philippines**

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## **Introduction**

This story of coffee in the Philippines starts with a farmer named Maybel. She is a smallholder coffee farmer in Negros province in the Philippines. She gains most of her income from growing, harvesting, and selling coffee. Once the time is right in the season, she harvests her coffee and moves to separate the coffee bean from the coffee fruit or cascara. This cascara is considered a waste byproduct of coffee production, commonly known as the fruit surrounding the coffee bean. Once separated and dried, she sells the green coffee beans to an aggregator and receives a profit. However, the story doesn't end there. There is still a key output unaccounted for which is the cascara. What does Maybel do with the cascara? She usually composts some but due to the amount of labor and space needed, it is easier to throw out the rest into the stream or let it decompose on land away from the coffee field. The farmers in this area have tried eating the fruit before and unanimously agreed that its taste is too bitter and unpleasant for mass consumption by the community. What if we tell you that with just a little bit of work, this waste byproduct can become a delicious, safe, and marketable food product in the form of cascara jelly? This study brings to you an innovation developed at UC Davis working with members of the Plant Sciences department and UC Davis Coffee Center.

For this study, there are three main sections of discussion and research. First would be the joint research approach with my research partner, Melina Devoney, developing, testing, and surveying regarding the cascara jelly product and process based on data gathered in-person. Second is the smallholder farmer economic and basic business feasibility and plan based on

remote survey data from two small farms in Negros, Philippines. Last is the analysis of a more sustainable and scaled up version of cascara jelly production using a cooperative model based on desk research.

## **Socioeconomic and Agroecological Setting**

In the Philippines, majority of coffee farmers have an average farm size of 1-2 hectares. Like the two of the farmers surveyed in this study, there is farm ownership by some coffee farmers, but some still operate on a leasing system. Coffee farms in the Philippines can sometimes utilize intercropping with fruit trees or forest trees. Based on the Philippine Statistics Authority, there are nearly 276,000 coffee farms in the country, with about 79.4 million trees. There are local small and medium coffee processors of roasted beans and ground coffee in the country. Negros, the province of focus in this study, is considered part of the Western Visayas region of the Philippines and is the 6th largest region in the country producing coffee. Top producers reside in the south of the country, Mindanao (DA and DTI, Coffee Roadmap, 2017-2022).

The agricultural province of Negros was chosen due to the higher elevation (Altitude: 500-1000m or 1,640-3,280 ft) which is a better environment for higher quality coffee beans and the willingness of farmers to participate in this coffee fruit jelly feasibility study (Philippine Coffee Board, 2020).

There are many limitations that exist with this study due to the recent COVID-19 pandemic affecting travel and everyday life of farmers around the world. Capturing recent coffee farm data and performance were not possible due to the country's strict domestic travel restrictions from 2020 to the present. Despite this hurdle, the research team found two farm partners to participate in the feasibility study and provide data to analyze the opportunities and

challenges of this project. To facilitate the survey and gather data, a key informant was utilized to support this research. The two farms are located in two different cities on the island of Negros. One farm resides in Bacolod, named BBGG Farm; the other resides in Dumaguete, named The Coffee Farm.

BBGG Farm's ownership is considered a sole proprietorship meaning there is only one owner. Under this farm, there is one coffee farmer that grows 1 to 2 hectares of coffee in collaboration with the owner. The primary focus of this farm is currently on livestock such as chickens and pigs with other farmers handling those operations. BBGG began planting coffee in 2015 slowly covering two hectares of land and plan to expand the coffee coverage in the next few years with the continued success of their coffee operations.

The Coffee Farm's ownership is also considered a sole proprietorship. Under this farm, eight coffee farmers that grow 15 hectares of coffee. The remaining 15 hectares are focused on growing trees such as mahogany, acacia, and apitong. The plans for the Coffee Farm include improving quality sufficient to export to the United States and Europe. Currently their coffee is sold domestically as well as to coffee exporters from China. In this property they have the postharvest infrastructure such as the bean depulping machine, bean washing and drying stations, and a storage shed.

When referring to coffee, we refer to green coffee which is the output produced by these farms, not roasted coffee. Their farm plot is classified as a standard a small coffee farm (Tay & Cox, 2018). For numerical data in this study, the assumed conversion is 50 PhP (Philippine peso) to 1 USD, since the value of the peso fluctuated between 48-52 PhP during the past 2 years (2020-2022).

According to the Philippine Statistics Authority 2019, the average income received by agricultural workers daily was PhP 312.51. Across regions, the biggest daily income rate was noted in CALABARZON at PhP 393.36, followed by MIMAROPA Region at PhP 367.74 and Ilocos Region at PhP 342.01. The lowest was recorded in Zamboanga Peninsula at PhP 240.68.

In terms of wage rate per sack, across commodities farm workers were paid an average of PhP 337.69 per day. Across regions, this ranged from PhP 268.34 per day in Central Visayas to PhP 428.83 per day in MIMAROPA Region.

On payment by contract the income rate of farm laborers averaged PhP 348.31 per day. It was lowest at PhP 284.73 per day in Northern Mindanao and highest at PhP 400.77 per day in MIMAROPA Region (Philippine Statistics Authority, 2019).

For coffee, farmers handle harvesting, applying compost and fertilizer, transport, and orchard management such as pruning, weeding, cleaning debris, monitoring, and other maintenance. Due to the extreme heat around noon, farmers have the option to take a break for 1-4 hours a day with most taking it around lunch time when the sun's impact is highest, and shade is minimal.

Based on data from the Department of Agriculture in 2015, some macroeconomic cost considerations for coffee farmers include labor, power, and fuel. In comparison to counterparts in Indonesia and Vietnam, Philippine labor costs are on par with a difference of a dollar or two on both the lower and upper scale (\$3.57 - \$7.14 per day). As for fuel and power, costs are significantly higher in the Philippines. \$1 - 1.05 per liter for diesel and \$1.26 - 1.33 per liter for gasoline. Electricity costs averaged \$0.15 - 0.16 per kwh, around two to three times more expensive than their Southeast Asian counterparts.

The table below is a scanned physical document from the Philippine Statistics Authority with the help of the key informant in Negros.

**PRODUCTION COSTS AND RETURNS  
OF SELECTED AGRICULTURAL COMMODITIES**

Table 25. Coffee: Average Costs of Production, Philippines, 2018 - 2020\*

ITEM	2018	2019	2020
	(in PHP per hectare)		
<b>CASH COSTS</b>	27,882	30,806	33,478
Fertilizer	7,834	9,269	10,819
Pesticides	152	176	184
Hired labor	16,003	17,300	18,260
Land tax	677	684	691
Rentals	60	62	62
Fuel and oil	270	272	264
Transport of inputs	195	197	204
Interest on crop loan	1,209	1,324	1,456
Food expenses	821	836	859
Repairs	666	687	700
<b>NON-CASH COSTS</b>	1,160	1,153	1,118
Hired labor (paid in kind)	274	297	313
Landlord's share	29	29	27
Harvesters' share	562	556	524
Lease rental	274	270	254
<b>IMPUTED COSTS</b>	10,436	11,387	11,869
Operator and family labor	6,026	6,515	6,876
Exchange labor	150	162	171
Depreciation	560	638	702
Interest on operating capital	1,473	1,665	2,072
Rental value of owned land	2,210	2,177	2,047
<b>TOTAL COSTS</b>	39,462	43,347	46,465
<b>GROSS RETURNS</b>	46,543	48,186	43,388
<b>RETURNS ABOVE CASH COSTS</b>	18,661	15,380	9,910
<b>RETURNS ABOVE CASH AND NON-CASH COSTS</b>	17,521	14,227	8,792
<b>NET RETURNS</b>	7,061	2,639	-3,677
<b>NET PROFIT - COST RATIO</b>	0.18	0.07	-0.07
Cost per kilogram (PHP)	74.16	80.87	86.79
Yield per hectare (kg/ha)	532	536	535
Farmgate price (PHP/kg)	87.47	86.17	81.04

\*Refers to maintenance costs only.

The input shares are based on the benchmarks generated by the 1998 Costs and Returns Survey of Coffee Production.

My research partner Melina Devoney who goes in depth to establish the social and environmental impacts of cascara waste in the coffee value chain while sharing her process of developing the open-access cascara jelly recipe (Devoney, 2021). Melina focuses on the possibility of utilizing this in the form of a consumable jelly for farmers in Huehuetenango, Guatemala. The goal of this paper is to assess the basic economic and business feasibility of cascara jelly potentially being included in the coffee value chain of farmers in Negros, Philippines. One of the goals of the research team is to build on research that is more accessible and comprehensible to farmers and the relevant stakeholders across the coffee value chain. As part of the collaborative portion of this research, Melina and I worked with the UC Davis Coffee Center and Trader Joe's to test liking scores and conduct sensory surveys to establish base recipes and a working proof of concept locally. Through the team's work, we believe there is a strong argument for expanding cascara jelly production to coffee producing countries as an additional source of income.

Globally, coffee trades as a commodity and thus is subject to price volatility affecting coffee farmers' returns. According to a study done by Bellwether Coffee, of the 12.5 million smallholder coffee farmers, at least 5.5 million live below the international poverty line of \$3.20 a day (For countries like Indonesia, Honduras, Uganda) (Caldwell, Gilman, & Terveer, 2021). The lack of income stability and low returns pose a vulnerability risk to these low-income coffee farmers around the world. Because of this, farmers and relevant stakeholders are finding ways to supplement farmers' income in a variety of ways such as increasing the quality of coffee, increasing yield, and utilizing products made from cascara. Aside from its potential economic benefit, utilizing cascara would divert what have been pollution in waterways and the air.



Filipinos consumed the equivalent of 198,000 metric tons of green coffee beans in 2020 and produced around 60,000 metric tons of green coffee beans for the same period (DA and DTI Coffee Roadmap, 2017-2022). With the current data available, it is estimated that annual demand growth would be around 13%. The trend of coffee consumption and production is steadily increasing in the Philippines with no signs of slowing. This growth comes with the increased risk of discarded cascara waste. With current coffee fruit waste practices in the Philippines, discarded coffee fruit pollutes land, waterways, and eventually the air. For this project, the mass ratio of green coffee to usable coffee cherry pulp is 20:47.1 based on a study done by UC Davis (Rotta, 2021). Out of that green coffee bean production, it is estimated that 141,300 metric tons of cascara is potentially available for utilization. Using the Coffee Cherry Company data for CO<sub>2</sub> diversion, the team estimates 0.794 kg of CO<sub>2</sub> diverted/ 1 kg of cascara (Coffee Cherry Co., 2019). In their study, they had a total of 127,591.82 kg of cascara and measured 101,265 kg of CO<sub>2</sub> diverted or  $101,265 \text{ kg CO}_2 / 127,591.82 \text{ kg} = 0.794 \text{ kg of CO}_2 \text{ diverted/ 1 kg of cascara}$ . Utilizing this cascara would divert 112,192.2 metric tons of CO<sub>2</sub> air pollution.

Growers in this region rely upon the long rainy season for irrigation which usually extends from June to November and historically provides sufficient irrigation for both coffee and timber trees. In the separation of the coffee bean from the cascara, the main component of waste is the cascara and coffee wastewater. Globally, coffee fruit ends up in landfills or waterways. After the coffee cherries decompose and ferment, it releases methane, which traps more heat than carbon dioxide. The wasted coffee cherries and wastewater also contribute to water acidification (Otalora & Felipe, 2018).

A study done by Ijanu, Kamaruddin, & Norashiddin attempted a to review coffee wet-processing wastewater treatment methods, on all current treatment techniques while

differentiating their advantages and their disadvantages. However, no study in their review had specific cost data associated with these wastewater treatment methods. This would be a crucial future area of study for coffee research (Ijanu, Kamaruddin, & Norashiddin, 2019).

Out of all the methods of treatment, the research team concluded by recommending the use of ion exchange process in the removal of organic pollutants in wastewater. However, there has not been any report of extensive use of ion exchangers in coffee processing wastewater management currently (Ijanu, Kamaruddin, & Norashiddin, 2019).

## **Problem and Solution**

The coffee value chain, far reaching and significant, inefficiencies create a chain of issues and problems from production to the distribution in the coffee shops and ultimately to consumers. One problem is in the form of a waste byproduct that comes from separating the cascara from the coffee bean in the postharvest processing of coffee. Currently much of the cascara translates into an environmental problem both locally and globally. The amount of cascara waste is around 23 million tons globally (Jaramillo Lopez & Ramirez Velez, 2017). Currently cascara waste in the Philippines, either is used as compost on the local coffee farms or is discarded. For the two small coffee farms in this study, that equates to around 10,964 kg of CO<sub>2</sub> air pollution. For this collaborative research, my research partner Melina Devoney gives the rationale for creating cascara jelly versus the options currently available on the market (Devoney, 2021). Another major issue in the coffee industry is the discrepancy between the income generated for the coffee farmers relative to all the other stakeholders throughout the value chain. Based on a study by the Philippine Department of Agriculture and Department of Trade and Industry, a typical coffee farm production cost is P55.33/kg green coffee. Additional expenses of

PhP 8.08/kg for primary processing which includes depulping, washing and drying of coffee beans. With an average buying price of P125/kg, a farmer's profit margin can reach P60.93.

With a buying price of P175/kg, the trader's margin is PhP 43.50 per kg. Processors make the greatest margin with a selling price of PhP 440/kg, the processing margin is PhP 224.66/kg. On average, the maintenance cost of producing a hectare of coffee was PhP 46,465 in 2020. The average yield per hectare of 535 kilograms while the farms in this study got slightly higher with 600 kg and 780 kg. After deducting cash costs, returns amounted to PhP 9,910 per hectare. With further reduction of non-cash costs, earnings settled at PhP 8,792 per hectare. Coffee production entailed a deficit of PhP 3,077 per hectare when all costs were deducted. (DA and DTI Coffee Roadmap, 2017-2022). This translates into a broad socioeconomic problem in the Philippines and undoubtedly for all small coffee farmers. As a result of these two major issues, our research team has worked to develop solutions to the waste generated by the coffee production process and income gap received by coffee farmers. Through extensive literature reviews and an assessment of the coffee fruit market, we were able to narrow our solutions to coffee fruit liquor and coffee fruit jelly. After some deliberation and initial feasibility assessments, it was determined that the coffee fruit jelly proposal would be the most feasible with respect to our resources and its potential ease of replication in coffee producing countries.

This project is significant on multiple fronts, one major consideration for this is the environmental aspect. This paper's particular focus, however, is on the economic and business potential for coffee farmers. Although there are other potential benefits such as nutrition since the coffee fruit jelly has a unique blend of nutrients that would have otherwise gone to waste. We focus here on the economic benefits of adding this value chain. Since the environmental and nutritional are more abstract and indirect, it is understandable why the coffee farmers

interviewed gravitated towards this potential benefit when talking about the product and value chain.

To establish the significance of this research and build on some of my research partner's findings on environmental and financial impact, the following are some key points (Devoney, 2021):

- “Most cascara is discarded and becomes a major soil and water pollutant as it ferments and degrades quickly, is very acidic and has a high biochemical oxygen demand in water (Otalora & Felipe, 2018).
- While some cascara is used as compost, its high nitrogen content and the anti-nutritional factors make composting laborious and land-intensive (Sanchez et al., 1999).
- Research showed significant reductions in downstream water quality during the coffee season; a large increase in organic loads, nutrients, and solids resulted in dissolved oxygen levels as low as 0.1 mg/L water. During the processing peak, the average pH of river waters dropped from 7 to 6.2. These changes decreased the diversity of macroinvertebrates (Beyene et al., 2012).
- One coffee farmer in El Salvador reported that selling cascara earned her a 480% premium over coffee beans: \$7 per pound of cascara versus the average of around \$1.20/pound of coffee (Perez & Patton, 2018).
- Underdeveloped cascara industry in coffee-producing regions due to the lack of 1) market collaboration and 2) local expertise in cascara processing in coffee-producing regions, and 3) patented processing methods that are inaccessible and unadaptable for most farmers.”

## Objectives

1. Develop a market satisfying and food safe cascara jelly recipe with in-country ingredient flexibility.
2. Gather qualitative and quantitative data on people's experience with coffee and the potential to make coffee fruit jelly.
3. Determine the costs, barriers, and opportunities for coffee fruit jelly production.
4. Determine a feasible business plan whether domestic or international, for Philippine coffee fruit jelly production.
5. Publish the methodology in two forms: for academia and for coffee-producing regions. The academic paper will discuss the socioeconomic impacts of the upcycled product, with a focus on the results of the on-farm feasibility survey and basic business plan. The farmer-focused publication will be a written recipe and information guide for producing cascara jelly as well as an instructional video.

## Methods

### **Product and Recipe Development & Testing done by Melina Devoney (Devoney, 2021)**

Fresh cascara was collected from Frinj Coffee in Santa Barbara, CA and transported in coolers to freeze at the U.C. Davis Coffee Center. The cascara was composed of a mix of coffee varieties from Frinj's farm (35% Caturra Rojo, 35% Geisha, 15% Cincateco, 15% Pacamara) and Toro farm (85% Geisha, 5% Caturra Rojo, 10% Pacas). Experimental trials were conducted to identify initial jelly recipes using various ingredients that were locally accessible to farmers in Guatemala and the Philippines. In each trial, cook temperature and time, quantities of sugar,

cascara, lemon and pectin were varied until satisfactory. Recipe quantities prioritized food safety, quality, and lowest cost.

### **Sensory & Farmer Surveys In Partnership with Melina Devoney (Devoney, 2021)**

All survey materials were approved by the U.C. Davis IRB Administration (IRB ID 1768032-1; Appendix 7)

#### **Preliminary Sensory Survey**

To reach the final three cascara jelly recipes, a preliminary sensory survey was conducted at the UC Davis Coffee Center. Due to the COVID-19 restrictions, participants asked to sample the jelly left in the breakroom refrigerator at their leisure and were unsupervised. They were asked to fill out a paper survey (Appendix 2) that captured qualitative data that identified flavor notes and drivers of liking. Participation was voluntary and unpaid.

#### **Sensory Survey - U.C. Davis Coffee Center**

The next sensory survey had three batches of jelly with varying proportions of lemon pectin. The survey was conducted during the UC Davis Coffee Center site dedication which included professionals from the coffee industry as well as UC Davis faculty and staff. Each of the three jars were labeled with randomized identifier numbers. Participants were instructed to read the consent form (Appendix 4) and ask any questions before starting the survey. The study investigators served each participant jelly on a spoon or cracker, and the participants filled out the RedJade sensory software mobile survey via their phone or on paper (Appendix 3). Participants were asked not to discuss their reactions with other participants at the booth. Participation was voluntary and unpaid.

### **Sensory Survey - Trader Joes, Davis, CA**

Permission was granted by the Regional Manager of Trader Joe's in Davis to do tastings and surveys with the crew members privately to limit the company's liability. In a similar method as the sensory survey in the UC Davis Coffee Center Site Dedication, the crew members at Trader Joe's have experience doing food and drink tastings as part of the company's culture of gaining product knowledge and being able to share honest feedback about each product to its customers; crew members are free to participate in monthly to quarterly food and drink tastings that include a wide range of products from wine to vegan entrees, which also include jams and jellies.

Participants were surveyed alone due to the restriction that participants could only do the survey on their breaks which were scheduled individually. Participants were instructed to read the consent form and ask any questions before starting the consumer survey. Cascara jelly samples were tasted on spoons with the option of having saltine crackers and water between samples. The survey was administered in a mobile format through a UC Davis account on RedJade sensory software.

For the privacy and safety of the participants, no personally identifying information was asked during the survey. Survey responses on RedJade are anonymous. Participants were not required to answer any of the questions if they chose not to answer, and it was emphasized that participation in research is completely voluntary.

### **Key Informant Communication & Farmer Surveys**

The key informant conversations and farmer surveys focused on the technical and economic feasibility, food safety measures, and farmer willingness. The survey aimed to identify

barriers to entry (such as access to capital, equipment, and clean water), production challenges, risk management, identifying a market, and identifying a product price.

Communication with the key informant was done primarily through online messaging and phone, considering limited access to stable internet and international calling rates. The key informant was first sent instructions and an Informed Consent to sign (Appendix 5.a). Thereafter, the informant was sent the final English-language jelly recipe (Appendix 1) so that they could confirm that farmers could purchase or otherwise access all the ingredients and equipment, and then estimate the itemized cost. The informant was also sent a spreadsheet to input the jelly production costs and log his hours at the minimum wage in Davis, CA of \$14/hour or 700 Philippine Pesos.

The key informant was asked to distribute the Consent Form (Appendix 5) and Farmer Feasibility Survey (Appendix 5.b) to as many relevant friends and family as possible. Each respondent was paid \$10 (500 Pesos) by the key informant. He was asked to provide assistance in filling out the survey to respondents who could not read and/or write. He was paid by check after the surveys were completed. Due to the informal and unsupervised distribution of the surveys (the key informant had no formal training), the results were analyzed on a more qualitative basis similar to a focus group, rather than a quantitative survey.

### **Information Dissemination to Farmers**

English recipe guides in both print and video format, were shared with the key informant and all survey participants to use and share as they please. The visual guide and video were posted on UC Davis' Coffee Center and International Agricultural Development websites for public viewing. The recipe guide can be found in Appendix 1.



## Results

### On-farm Feasibility Survey

The key informant distributed surveys to 11 participants from two coffee-growing farms: BBGG Farm in Bacolod and The Coffee Farm in Dumaguete. All participants were coffee farmers, including the two farm owners. All participants worked for a small farm or small business, less than five workers to up to 10 workers, on farmland between 1 - 5 hectares. Two were farm/business owners and the rest were employees. Of the 11 participants, 3 were female (1 owner) and the other 8 were male (1 owner). 4 participants were in the 18-24 age range, 2 participants in the 25-34 age range, 2 participants in the 35-44 range, and 3 in the 55-64 age range. The two farm owners have college degrees. The rest of the farmers either finished elementary or had a few years of elementary education. (Table 1).

Table 1: Participant Demographics							
Membership	Job Title	Job Position	Farm/Business Size	Highest Education	Gender	Age	Age
Dumaguete	Coffee Farmer	Owner	1-5 hectares	Primary	Male	18-24	25-34
9	11	2	11	9	8	4	2
Bacolod	Coffee Roaster	Coffee Farmer	<5-10 Employees	College	Female	35-44	45-64
2	0	9	11	2	3	2	3

All participants indicated that they would consider making the jelly recipe, either for their families (11 participants) or to sell locally (6), either in their homes (4) or at their farm owner's business (11), where they all have access to clean water, space, and equipment. However, the participants noted some obstacles they would have to overcome to do so (Table 2).

Table 2: Jelly Production Logistics			
Recipe Comprehension	Free time to make jelly on a typical workday	Access to clean water	Byproduct generation and use
Most of the steps aren't clear or are difficult to understand	1-4 hours	At the owner's property	Spent cascara and citrus remains
3	11	1	11
Some steps aren't clear or are difficult to understand		At the workplace	
5		11	Use for compost and/or fertilizer
Everything is easy to follow and understand		At home	11
3		6	

Majority of the respondents said that either some or all of the recipe was unclear or difficult to understand. This confusion stemmed primarily from lack of easy access to specific equipment and ingredients for the recipe particularly making the pectin, the alcohol test, and the pH calculation. All respondents had limited free time to make the jelly on a typical workday; participants only had 2-4 hours of free time, approximately how long it takes to prepare, make, and clean up after a batch of jelly (about 3-4 jars). If participants planned on making the jelly to sell on a larger scale, adjustments to their current routine must be made at work or at home. As will be mentioned later, more studies on larger batch recipes and processes need to be done in order to guarantee recipe scalability while maintaining product quality.

One of the key findings from the survey was the consensus that it would be difficult to access and purchase all the equipment and ingredients; obtaining an accurate food scale, a refrigerator/freezer, and the cost of a sufficient amount of citrus fruits is difficult. To make the

recipe feasible, most participants would need to adapt locally available equipment and ingredients. A few participants mentioned that a tasting and demonstration would be helpful to gauge the local taste preferences as well as better understand the process of making the jelly.

Now that there is a sense of the physical feasibility of making the cascara jelly, a breakdown of the costs and potential sales of this product would shed light on its economic and business potential and feasibility.

For this analysis, the target costing method is utilized to determine the limit of the cost for the cascara jelly and its selling price. Based on the key informant's trip to the local markets, they gathered that alternative products such as strawberry jam, coconut jam, and peanut butter were priced around 50-100PhP per 250g. Using the cost-plus pricing method, the minimum selling price is around P50 based on the breakdown of variable costs of the cascara jelly. With these values, the team will test the selling price at P60, P75, and P100.

The following is a break-even point analysis of the cascara jelly making process. Fixed cost breakdowns can be found in Appendix 6. For this project, the mass ratio of green coffee to coffee cherry pulp is 20:47.1 based on a study done by UC Davis (Rotta, 2021).

60kg green coffee= 141.3kg coffee cherry pulp

Total Variable Cost		
Ingredients and materials	Per batch (3 jars, ~27oz or ~765g)	Per jar (~9oz or ~255g)
6 cups of fresh cascara (~500g)	0	0
4 cups of mineral water	1	0.33
4 lemons	75	25
Cane sugar 500-600g	25	8.33
Jar and lid	15	5
Domestic freight	.75	.25
<b>Total</b>	<b>116.75</b>	<b>38.92</b>

Break-even units= Total Fixed Cost/ Selling Price-Total Variable Cost

Selling price= 60PhP

Break-even units=  $1,125 / (60 - 38.92) = 53.36$  units or 54 units rounded up

Break-even sales=  $54 \times 60\text{PhP} = 3,240\text{PhP}$

Selling price= 75PhP

Break-even units=  $1,125 / (75 - 38.92) = 31.18$  units or 32 units rounded up

Break-even sales=  $32 \times 75\text{PhP} = 2,400\text{PhP}$

Selling price= 100PhP

Break-even units=  $1,125 / (100 - 38.92) = 18.42$  units or 19 units rounded up

Break-even sales=  $19 \times 100\text{PhP} = 1,900\text{PhP}$

Based on these break-even scenarios, it would be ideal to have a selling price in the range of 75PhP to 100PhP to significantly reduce the number of units needed to break-even and eventually become profitable. The smaller number of units needed also translates to less time and effort by the farmer. The Dumaguete farm has 15 hectares of coffee trees that yielded around 13 bags/hectare at 60kg/bag. The Bacolod farm has 2 hectares of coffee trees that yielded around 10 bags/hectare. Using the 60kg green coffee to 141.3kg coffee cherry pulp ratio, this gives the Dumaguete farm roughly 27,553.5kg of coffee cherry pulp to work with annually and the Bacolod farm 2,826kg of coffee cherry pulp. Using the Coffee Cherry Company conversion methodology of 0.794 kg of CO<sub>2</sub>/ 1 kg of cascara, it can be estimated that utilizing this cascara would divert 24,121.32 kg of CO<sub>2</sub> air pollution in these two farms. These numbers illustrate that there is no shortage of usable cascara, however, other logistical issues would arise such as storage and scaled production.

In order to support an enabling environment for success, a basic business plan for smallholder farmers has been developed and will be discussed to serve as a customizable base template for future cascara jelly producers.

## **Business Plan**

### **Target market**

For domestic sale and distribution, the most logical market to target would be consumers who value caffeine and its beneficial properties as well as jam or jelly consumers. For these smallholder farmers, this target market includes those closest to their vicinity all the way to the nearest town proper or city center. The cascara jelly has a strong unique selling point in that it provides nutritional and caffeine benefits which should provide enough demand and differentiation to compete with other comparable products at relatively close prices. The high liking scores in the research team's initial tests suggests that there is an inherent appeal in terms of flavor profile. Paired with the familiarity of coffee products, the barrier to first consumption remains low. Outside of taste and nutritional benefits, the production of this product has environmental and social benefits for the farmers' community and environment.

The two major cities in Negros Island are Bacolod and Dumaguete. Bacolod has a population of 600,783 with 62.35% of those being above 18 years old or roughly around 374,588 adults. Dumaguete on the other hand has a population of 134,103 with 64.77% of those being above 18 years old or roughly around 86,858 (PhilAtlas, 2020). This gives us a total population of 461,446 adults who can potentially purchase a caffeinated product such as cascara jelly. Based on a study by Kantar Worldpanel Philippines, data showed that on average 93% of Filipino households buy coffee at least once a week (Rappler, 2015). Utilizing that percentage, the population becomes 429,144 adults who consume coffee once a week on average. This is a rough

estimate but provides an optimistic case for demand of coffee related products in Negros province. With the current production time and practices, the farmers in this study can only make 1,095 jars of cascara jelly per year if they made one batch per day (2-4 hours of free time per day). That equates to 12,045 jars of cascara jelly annually for all 11 coffee farmers in this study. To put that into perspective, that is 2.8% of the 429,144 adults buying the product once a year.

#### Target Market

##### 1) Demographic

- a) Age- 18 above, due to caffeine content.
- b) Income- low to mid-level income initially based on nearby community with potential to reach high-level income community in select market events or eventually with more mainstream distribution.
- c) Education- not as significant, but more marketable and compelling to those with knowledge of the benefits of caffeine and cascara generally and the impact of waste products and CO<sub>2</sub> emissions on the environment.

##### 2) Psychographic

- a) Social status- low to mid-level income
- b) Values- environment and sustainability, value/savings, financial inclusivity
- c) Interests- physical or strenuous activity, outdoors, sports
- d) Lifestyle preferences- active, on the go, uses and needs energy, long hours of work

##### 3) Geographic

- a) Province or state - Negros
- b) City- Bacolod, Dumaguete
- c) Region- Visayas

#### **Organization, management, and business model**

Based on my informational interview with the owners of the BBGG Farm and The Coffee Farm, they expressed a willingness to test and try out this process by being the leads on demonstrating the coffee fruit jelly process to their team of coffee farmers. With their

willingness to gather the initial resources and equipment needed for the coffee fruit jelly making process, the farmers' risk would not be as significant logistically or financially. Due to the timing of this research and covid restrictions in the country, they were not able to utilize or preserve the coffee fruit to test out the UC Davis developed coffee fruit jelly recipe.

Most of the farmers involved have worked in agriculture for years and some even decades. Educational attainment ranges from a few years of elementary school to completion of elementary school. The two participants with college degrees are the two owners of the coffee farms.

BBGG Farms and The Coffee Farm are both sole proprietorship companies that employ coffee farmers to work in their farms. The structure of their organizations is flat with most authority held by the two coffee farm owners. For this sole proprietorship coffee venture, the business proposal is to implement a profit-sharing model with its farmer employees so as to alleviate the risks and difficulties regarding the initial capital for cascara jelly production. Based on a study by Elizabeth Bennett and Janina Grabs, this business model has been successful in various coffee value chains even compared to fair trade cooperative practices.

Some key findings from this study regarding profit sharing include the following (Bennett & Grabs, 2021):

- Distributes more value to suppliers than the conventional market, increases the amount of value created, and improves stability of supplier incomes.
- Companies that engage in profit sharing can scale up or deep, meaning they have the flexibility to adjust their growth or lack thereof while covering the necessary business operations.

## **Product description**

The goal is for smallholder coffee farmers or coffee cooperatives to make products out of cascara or coffee fruit, particularly the cascara jelly that was developed at UC Davis. This product would be marketed towards jelly and coffee consumers alike. Some key points about the product that will be highlighted are the waste reduction measures it supports as it is an upcycled product. The natural caffeine found in this product will also be another strong selling point. Cooperatives would be the ideal type of organization to scale this operation while mitigating risks involved with such a new endeavor for smallholder farmers. With its established network in the coffee value chain, adding another product would theoretically be easier than if the network was not established beforehand. Overall, this product has shown its potential as a desirable consumer product based on the initial sensory panels done at UC Davis with ingredients that are readily available in local markets such as Negros, Philippines.

## **Marketing and sales**

With the current cascara jelly production capabilities, the target sales for the first quarter of operation would be to at least reach the break-even quantity of 32 jars of cascara jelly at a selling price of 75PhP or 19 jars at 100PhP. For the local market that these coffee farmers have, the biggest draw for trying the product would be its caffeine content. To establish the validity of the caffeine claims, my research partner Melina Devoney did an initial set of calculations for the cascara jelly below (Devoney, 2021):

### **Caffeine & chlorogenic acid per jar - Calculations**

- Each batch of cascara jelly uses approximately 500g of cascara.
- Fresh coffee pulp is 0.28% caffeine and 2.6 - 2.71 % chlorogenic acid (Bressani & Braham, 1979).



- It is assumed that all caffeine and chlorogenic acid is transferred into the juice since caffeine is highly soluble in boiling water (Caffeine solubility, content in coffee beans and extraction, 2016) and chlorogenic acid can be extracted in water as well.

$500\text{g cascara} \times 0.0028 = 1.4\text{ g} = 1400\text{ mg caffeine/batch}$  (~ 2, 8-oz jars), or 700 mg caffeine/jar

16 tbsp per 8-oz jar:  $700\text{ mg caffeine} / 16 = \mathbf{43.75\text{ mg caffeine per 1 tbsp serving}}$

$500\text{g cascara} \times 0.0265 = 13.25\text{ g} = 13,250\text{ mg chlorogenic acid/batch}$ , or 6,630 mg/jar

$6,630\text{ mg chlorogenic acid} / 16 = \mathbf{414.38\text{ mg chlorogenic acid per 1 tbsp serving}}$

Transferring this knowledge to the consumer, cascara jelly producers have the opportunity to entice new caffeine consumers with a product that is eaten or paired with common household snacks such as bread, crackers, and the like. The customer base that is already used to consuming cups of coffee or fruit jellies would also be a key target for the marketing and sale of cascara jelly. For the early stages of cascara jelly production, sales would probably begin door-to-door in their local barangays and spread via word of mouth. It would also be feasible for them to sell directly from their home, consign with a local market vendor, or even consolidate the cascara jelly and work with the coffee farm owners for broader distribution.

Potential products similar to Cascara Jelly:

- Sports energy gel- With the proof of concept developed with the early research conducted, a natural product that is envisioned is cascara jelly integrating into what would be consumable sports energy gels. These gels are popular with all kinds of athletes such as runners and cyclists to easily replenish energy in a portable form while actively engaging in their respective sports. These products usually contain electrolytes,

carbohydrates, and caffeine. Coffee fruit jelly would be a natural addition to their current ingredient list.

- Cascara jam or syrup- Similar to caramel or chocolate syrups, coffee fruit jam or syrup can be integrated into various confectionery products, desserts, and possibly even savory dishes.
- Cascara liquor- Currently, only one distillery in the United States sells cascara liquor regularly on the market. New Deal Distillery's cascara liquor has 25.6% alcohol content per 750 ml bottle. Ingredients include cascara, cane sugar, and grain neutral spirits. Currently it is marketed as a cocktail ingredient or digestif.
- Cascara beverages- There are several variations of these cascara beverages starting to penetrate the market. Riff is a new plant-powered sparkling energy drink marketed to have vitamin C, antioxidants, pure ingredients, and clean caffeine. Husky is a sparkling cascara tea beverage with three ingredients namely cold-brewed dried coffee fruit tea, citrus juice, and carbonated water.
- Dry cascara products- Products such as dehydrated cascara tea or cascara powder can be used in food ingredients, baking, mixing with water to create a tea drink, and for nutraceutical and cosmetic use as an antioxidant supplement.

## **Financial Projections**

The following table is a conservative projection of cascara jelly production and sales for the first five years of operation. With the current free time available, farmers are only able to make one batch of cascara jelly per day using the method developed by the research team which equates to 1,095 units of cascara in a year. Year 1 assumes that only 25% of the total possible production is done with a total of 262 units that year. After selling 32 units (12.5% of 262), the

farmer would be able to cover the fixed costs of the equipment needed for cascara jelly production. After the 32<sup>nd</sup> unit, each unit will result in net profitability for the farmer since the cost of goods sold (COGS) will be covered for succeeding production and sales. Year 2 conservatively assumes only 50% of the 1,095 units produced and sold while year 3 reaches the daily batch production of cascara jelly. For year 4 and 5, assuming no change in farmer schedule and availability, another member of the household or community would participate in order to double and triple production for those years respectively.

	Year 1	Year 2	Year 3	Year 4	Year 5
Units	262	547	1,095	2,190	3,285
Revenue (@P75)	P19,650	P41,025	P82,125	P164,250	P246,375
COGS (@P38.92)	P10,197.04	P21,289.24	P42,617.40	P85,234.80	P127,852.20
Profit (@36.08)	P9,452.96	P19,735.76	P39,507.60	P79,015.20	P118,622.80

The following table is a more optimistic projection of cascara jelly production and sales for the first five years of operation. Year 1 assumes that the farmer will create a batch of cascara jelly per day reaching 1,095 units for the year. Year 2, 3, and 4 would require an additional person from their household or community to produce multiple batches daily throughout the year with majority of their time dedicated to making cascara jelly. Year 5 is a projection that assumes that all the available cascara is utilized and divided amongst the 11 farmers in this study. However, with current production, this is not feasible and more testing on bigger batches is necessary to fulfill this cascara jelly production goal.

	Year 1	Year 2	Year 3	Year 4	Year 5
Units	1,095	2,190	3,285	4,380	16,570
Revenue (@P75)	P82,125	P164,250	P246,375	P328,500	P1,242,750
COGS (@P38.92)	P42,617.40	P85,234.80	P127,852.20	P170,469.60	P644,904.40
Profit (@36.08)	P39,507.60	P79,015.20	P118,622.80	P158,030.40	P597,845.60

## Cooperative Environment and Potential

The following cooperative data is based on a short telephone interview with a licensed Agriculturist from the City Agriculture Office, San Carlos, Negros Occidental - High Value Vegetable Section. He has more than 20 years of agricultural and development experience both in the private sector and the government covering different provinces in Visayas. He states that the difficulty in finding recent published agricultural data online is the lack of priority within the various government agencies. Reporting is mostly done internally within the local government units and departments.

As of 2022, of the 6 cooperatives under his jurisdiction, half have shared that they are still having difficulties in accessing their farm sites due to the current quarantine protocols despite their more relaxed policies compared to 2020 and 2021. Almost all have reported challenges related to transportation of material and harvest. 5 of the 6 cooperatives have staff that experienced limited mobility while also being concerned with security and penalties for quarantine violations.

Membership benefits of cooperatives was gravely affected by the pandemic. Almost all of the cooperatives reported withdrawing from their capital build-up fund. Half of the cooperatives also shared that despite the move into General Community Quarantine, their

organizations had difficulty communicating with members due to various factors such as limited cellular connectivity and lack of physical presence.

Cooperatives continued to extend various forms of assistance to their staff during the General Community Quarantine. Aid came in the form of personal protective equipment, accommodations near the workplace or farms, transportation, groceries or food assistance, vitamin supplements, and cash.

A cooperative with a microfinance arm reported to have staff from other departments support branch activities to serve as back-up, especially for monitoring and providing assistance to their members. Payment collections and trainings were limited as overall mobility is still limited.

Despite the current limitations of cooperatives in Negros province, there is still strong potential to tap into the ecosystem of these farmers in order to reach a more sustainable scale of cascara jelly production. In order to utilize as much cascara waste as possible, smallholder farmers have to eventually reach a scale on par with the level of cooperatives who have enough resources to safely store cascara and prevent further fermentation before processing as well as having the facilities and sufficient capital produce enough cascara jelly. One significant difference would be having dedicated people focused on cascara jelly production while the supplying coffee farmers can focus on their operations as usual.

The cooperative level would provide better access to resources, leverage better marketing and business opportunities, provide training, and have more staff that work in administration, education, and research. With the cooperative network, farmers would have better access to affordable inputs like seeds, fertilizer, and the like. Other benefits include credit, information, technology, and certifications.

With the cooperative model, there are multiple costs trade-offs associated with it. Theoretically, the additional collective resources generate higher income for member farmers. Cooperatives bring about more bargaining power for more credit, lower interest rates, higher selling price, lower input costs, and lower transportation costs. This network also provides for stronger market linkages and economies of scale for certain production practices. Initially however, increase in costs such as fixed fees for machinery and equipment access (lower overall since individual farmers cannot purchase these themselves), collective marketing costs, and overhead costs associated with more administrative staff (Milford, 2004).

In a study done by Root Capital, producers reported utilizing the extra cooperative income to pay for household needs such as food, clothing, medicine, and on farm investments. 72% of members reported experiencing regular food insecurity but because of the additional income they were able to mitigate those risks. Cooperative financing has also enabled the cooperative to start providing advance payments to its members upon delivery of their coffee, rather than paying them several months later at the end of the coffee season (Root Capital, 2018).

For the Philippine context, there is a limitation in coffee cooperative data due to the lack of publicly available cooperative data and research. Instead, some insights from a comparative coffee cooperative study in Nicaragua are utilized in the following section to gain more insights.

This study analyzed various coffee cooperatives' business models, upgrading strategies, and SWOT features. Because of the variability between cooperatives, it was not possible to conclusively declare significant causality between impact of one cooperative's strategy to its results. There was no significant association to their respective gross margins as well. Overall, gross margins and economic benefits were dependent on the quality of the services the cooperative offered its members and individual yield levels and quality. Cooperatives empower

farmers by giving them the opportunity to make more informed decisions about membership, upgrading of production systems, certification, marketing, and operations (Beuchelt & Zeller, 2013).

With the limitations of individual farmers in terms of time, capital, and equipment resources, the cooperative model would be the ideal vehicle for cascara jelly to be produced, scaled to the level of full utilization of waste, and overall income benefits to all farmers involved.

## **Conclusions and Recommendations**

Through the research team's efforts, it demonstrates that cascara jelly has high liking scores while also being economically feasible on the small farm level. Based on the economic and financial analyses, it would not take too much effort to be profitable on the domestic level.

The earning potential of cascara jelly is there. The Dumaguete farm has roughly 27,553.5kg of coffee cherry pulp and the Bacolod farm has 2,826kg of coffee cherry pulp to work with annually. This can be translated to 182,277 pcs of 8 oz jars of cascara jelly if production is maximized, and demand is maximized. This would amount to P13,670,775 of potential revenue for farmers at a selling price of P75. To be realistic however, with current cascara jelly production practices and limitations, this full output is still not possible due to the time restriction in making the cascara jelly. At the current production rate, each farmer can produce 3 jars of cascara jelly a day or 1,095 jars of jelly annually if they made it every day. That amounts to P82,125 of revenue if they were able to sell of the jars produced. Each farmer is currently only able to make a batch per day or 3 jars of jelly in the amount of free time they have daily. Environmentally, the local waste diversion potential is there. For the two small coffee farms in this study, that equates to around 24,121.32 kg of local CO<sub>2</sub> air pollution diverted annually if all the cascara is utilized. However, this whole process has tradeoffs particularly with

the addition of glass jars to the equation which the team analyzed and summarize in the following table.

Cascara Amount	Cascara CO <sub>2</sub> Emissions	CO <sub>2</sub> Social Costs Cascara (\$56.20/metric ton)	Glass Jar CO <sub>2</sub> Emissions (0.47 CO <sub>2</sub> /jar)	Glass Jar CO <sub>2</sub> Emissions (cradle to cradle life cycle)	CO <sub>2</sub> Social Costs Glass Jars (\$56.20/metric ton)	Net profit
	0.7937 kg of CO <sub>2</sub> / 1 kg of cascara	CO <sub>2</sub> Emissions/1000 kg * 56.20	X= # of batches 3x= # of jars 3x* 0.227 = kg of glass	1 metric ton of recycled glass saves 670 kg of CO <sub>2</sub>	CO <sub>2</sub> Emissions/1000 kg * 56.20	P36.08 @ P75 selling price \$1 = P50
3,037.95 kg (10% of available)	2,411.22 kg	\$135.51	8,565.75 kg CO <sub>2</sub>	5,791.95 kg CO <sub>2</sub>	\$325.51	P657,558 or \$13,151.16
30,379.5 kg (100% of available)	24,121.32 kg	\$1,355.61	85,670.19 kg CO <sub>2</sub>	57,912.09 kg CO <sub>2</sub>	\$3,254.66	P6,576,554.16 or \$131,531.08

From solely measuring CO<sub>2</sub> emissions, the production of cascara jelly has a higher CO<sub>2</sub> output per kg of cascara. One of the key factors to consider here is where that CO<sub>2</sub> affects the environment. Local cascara waste would increase the nitrogen and the acidity of the soil and water while also increasing the biochemical oxygen demand in water which disrupts the ecosystem. Essentially, leaving the cascara to decompose in the soil or water affects the local coffee producer's immediate environment while the creation of the glass jars occurs mostly near Manila or in China. To measure the social cost of CO<sub>2</sub> emissions, the United States National Academies of Sciences, Engineering, and Medicine values the social cost of carbon at \$51. They define the social cost of carbon as an estimate of the economic costs, or damages, of emitting one additional ton of carbon dioxide into the atmosphere (Rennert et al., 2021). There is a higher CO<sub>2</sub>



emissions social cost associated with cascara jelly production with a cost of \$3,254.66 versus a cost of \$1,355.61 for leaving cascara as is in the Philippine coffee value chain.

With these indirect social costs in mind, the team then measures this against the monetary value of cascara jelly production despite the initial higher social costs. With 11 farmers having an average amount of 2-4 hours of free time a day, cascara jelly production capacity is at 12,045 units without any major changes except that a batch of cascara jelly is produced per day for 365 days. With a selling price of P75, the profit on those 12,045 units is P434,583.60 or \$8,691.67 (2,007.50 kg of cascara) which is more than double the \$3,254.66 social cost of cascara jelly production (30,379.50 kg of cascara). The direct economic benefit of this type of income would lead the research team to strongly recommend cascara production despite the higher initial indirect social cost of CO<sub>2</sub> emissions.

Nestle Philippines has a coffee program aimed at improving farmers' coffee production and increasing their income through trainings, access to better inputs, and access to markets. Before they started, the average net income of a coffee farmer was around P30,000 in 2018. The same group of farmers that participated in their program reached an average net income of around P90,000 in 2019 (Nestle Philippines, 2020). For the coffee farmers in this study, their net income ranged between P70,000 to P80,000. The World Bank categorizes this income as slightly above the international lower middle-income poverty line (\$3.20) but keeps farmers in a vulnerable position to any changes in circumstances and the current working environment (World Bank Group, 2021). The financial projections, even the conservative ones, illustrate how significant this additional potential income stream is to smallholder farmers. Assuming even just 50% annual individual cascara jelly production capacity, a farmer can make around 25% more net income.

The farmer survey indicated that economic barriers exist for farmers in jelly production, however, there are less restrictions from the coffee farm owners. Individual farmers generally lack access to capital and equipment to produce cascara jelly in their homes but are open to producing jelly if these barriers are removed. The farmers involved in this survey agreed that if they had the resources, they would be more than willing to make the jelly. Utilizing the resources of the coffee farm owner or even a cooperative would be feasible ways to solve this issue. Ideally, a strong network of cooperatives would be in charge of scaling up production and distribution of cascara jelly thus utilizing the cascara available in coffee value chains and significantly increasing coffee farmer incomes.

This study covers only two very small coffee farms relative to the entire global coffee industry. Ultimately, the projections for individual farmer cascara jelly production are only to illustrate a starting point for many farmers that not fully part of larger organizations like cooperatives. This is one path to reach a greater scale and impact. A similar study on a much larger scale such as cooperative organizations is necessary to achieve more generalizable insights and conclusions. However, with this study as an early perspective and preview of the potential of cascara jelly production, the research team believes that the conversation is being pushed forward substantially along with other private and public stakeholders pursuing their own developments.

Cascara jelly parameters are bound to vary across farms, organizations, and even countries. Climate and the farm's working environment is a key variable affecting many aspects of production and yield. Different starting assets and resources would also affect the farmers' ease and capabilities implementing this additional value chain. Government factors such as regulatory policies from the Food and Drug Administration or the Bureau of Customs would

affect the timeline, cost, and difficulty of scaling the production and sale of cascara products domestically and abroad. Ultimately however, the research team sees tremendous economic and environmental potential for cascara jelly and other cascara products. It starts with one jar, but the impact will be exponential.

### **Limitations and Confounding Factors**

Because this study was not conducted in the country of focus, the Philippines, some limitations and confounding factors exist.

Frinj Coffee, the supplier of the cascara used in this project, is located in Santa Barbara, CA. Different coffee cultivars from different geographic regions have different nutritional profiles; particularly the caffeine and Brix content. The cascara from Negros coffee varieties could have different pH and Brix levels, and require adaptation and adjustments of the jelly recipe developed using the cascara from California coffee cultivars.

The cascara used in this project was frozen for storage, not with fresh cascara. More data gathering on the storage possibilities and timeframes should be done for broader implementation. Despite the team's initial feedback on the bitterness of the cherry skin, future studies should attempt making jam recipes. Utilizing the cascara from Negros could yield different flavor profiles, nutritional values, caffeine amounts, and other factors that could alter the jelly quality and thus need some adjustments to the recipe.

A limitation of this study was our inability to visit a coffee farm in the Philippines. A confounding factor that arose from our inability to travel to the Philippines was that the key informant had no formal training in survey distribution. In the farmer survey, full confidentiality was impossible since some participants have limited reading and writing skills, requiring the key

informant to read and write for them. Due to the COVID-19 limitations, there was only small population of coffee farmers in the said areas available for this project. Further surveys, focus groups, and demonstrations with participation from the farmers would be ideal to ensure the participants fully comprehend the jelly making process and the survey questions.

### **Future Recommendations**

For more immediate studies building on this research, it is necessary to do more in depth nutritional analyses and shelf-life experiments on these products in varying conditions. To reduce cost of shipping and possibly improve on sustainability, research on different types of packaging for the cascara jelly would also be useful for producers. Additionally, research on varying cascara jelly batch sizes and their respective recipes would be required to better analyze the scalability of this product while maintaining product quality factors such as nutrition and taste.

A worthwhile study to be done would be a life cycle assessment (LCA) of the whole coffee value chain including the cascara jelly production which would include the individual LCA of the cascara jelly production relative to the coffee value chain. Using similar methodology as this study, one can utilize some key frameworks and apply this to another coffee producing organization or geography. A comparative net present value analysis in addition to this LCA would be a good baseline for producers to start analyzing different cascara products in their traditional coffee value chains. After which a comparative analysis tool of cascara products could be developed and would be a good resource for farmers still deciding which way would be ideal for to utilize the cascara in their farms. Researchers can look into the different costs, trade-offs, and benefits of each cascara product. With a comprehensive list, farmers would be in a

better position to assess their own situation and resources to implement and create their own cascara product.

For environmental impact, it would be interesting to assess and measure the environmental landscape of a coffee producing area before and after it implements cascara jelly production into its value chain. As for economic impact, multiyear sales and growth of cascara jelly for a particular organization or geography should provide data on the financial and economic impact of this endeavor.

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## Appendix

- 1. Jelly Recipe - Visual Guide:** English, Tagalog, Hiligaynon      **Video:** [How to Make Cascara Jelly](#)
- 2. Informal Sensory Survey Results** (UCD Coffee Center 4/15/21)
  - Ingredients: Demerara sugar, organic cascara, lemon juice, water, pectin, calcium
  - Made 4/12/21



- Total survey responses: 7

### Liking

What is your OVERALL OPINION of this sample? (circle your answer):

Extremely Dislike	Dislike Very Much	Moderately Dislike	Slightly Dislike	Neither Like nor Dislike	Slightly Like	Moderately Like 	Like Very Much 	Extremely Like 
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How much do you like or dislike the APPEARANCE of this sample? (circle your answer):

Extremely Dislike	Dislike Very Much	Moderately Dislike	Slightly Dislike	Neither Like nor Dislike 	Slightly Like 	Moderately Like 	Like Very Much 	Extremely Like
-------------------	-------------------	--------------------	------------------	------------------------------	-------------------	---------------------	--------------------	----------------

How much do you like or dislike the FLAVOR of this sample? (circle your answer):

Extremely Dislike	Dislike Very Much	Moderately Dislike	Slightly Dislike	Neither Like nor Dislike	Slightly Like	Moderately Like 	Like Very Much 	Extremely Like 
-------------------	-------------------	--------------------	------------------	--------------------------	---------------	---------------------	--------------------	--------------------

How much do you like or dislike the MOUTHFEEL of this sample? (circle your answer):

Extremely Dislike	Dislike Very Much	Moderately Dislike	Slightly Dislike	Neither Like nor Dislike	Slightly Like 	Moderately Like 	Like Very Much 	Extremely Like
-------------------	-------------------	--------------------	------------------	--------------------------	-------------------	---------------------	--------------------	----------------

### Adequacy of Select Attributes – Just-About-Right (JAR) Scaling

**Flavor (Aroma, Taste & Trigeminal)** – Please indicate how you feel about the flavor of the jelly (circle your answer):

Much Too Weak	Somewhat Too Weak 	Just About Right 	Somewhat Too Strong 	Much Too Strong
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**Acidity** - Please indicate how you feel about the acidity of the jelly (circle your answer):

Much Too Low	Somewhat Too Low	Just About Right 	Somewhat Too High 	Much Too High
--------------	------------------	----------------------	-----------------------	---------------

**Sweetness** - Please indicate how you feel about the sweetness of the jelly (circle your answer):

Much Too Sweet 	Somewhat Too Sweet 	Just About Right 	Somewhat Too Sour	Much Too Sour
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**Consistency** - Please indicate how you feel about the consistency of the jelly (circle your answer):

Much Too Thin/Runny	Somewhat Too Thin/Runny      *	Just About Right 	Somewhat Too Thick/Gelled   *	Much Too Thick/Gelled
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\*\*“both (inconsistent)”

**Description of the Jelly – Check-All-That-Apply (CATA)**

From the list of attributes/features in each category below, please circle all that apply to this jelly:

**Flavor (Aroma, Taste & Trigeminal)**

Fruity 	Vegetal
Citrus 	Floral 
Red Berry 	Earthy
Cherry 	Sugar 
Stone Fruit 	Caramel/Brown Sugar 
Grape 	Molasses
Apple 	Maple 
Fig 	Honey 
Date 	<b>Other:</b> <ul style="list-style-type: none"><li>● Lemon &amp; lime</li><li>● Marmalade</li><li>● Lemon</li></ul>

**Body/Mouthfeel**

Smooth 	Viscous 	Thin 
------------	-------------	----------

Grainy 	Sticky 	Syrupy 
Clumpy 	Gelatinous	Thick 
<b>Other:</b>		

### Holistic/Hedonic

Aromatic 	Balanced/Blended 	Bland/Flat
Complex 	<b>Other:</b>	

### Defects

Rancid/Rotten	Fermented 	Burnt
Medicinal 	<b>Other:</b> <ul style="list-style-type: none"> <li>Vinegary aroma specifically; fermented/vinegary aroma - not off putting to me but maybe to others</li> </ul>	

### Open Comments

What specifically did you **like** about this jelly:

- The fruity flavor was refreshing and sharp, I liked the texture, good balance of sweet and sour
- Balance between sweet and tart, lemon was not overpowering, good aromatics
- Surprised! First time trying coffee cherry jam, tastes like some kind of berry jam. I like the complexity and fresh feeling fruity flavor.
- I liked that it was smooth and overall had a nice flavor that wasn't too overpowering in any way.
- Flavor was clean and very fruity, like a marmalade. Very sweet which was balanced in flavour.

- Sour/sweet contrast, overall flavor is great
- I like that its citrusy w/ lemon. I like the complex fruity.

What specifically did you **dislike** about this jelly:

- Almost had an astringent aftertaste, color was a little dull but not too off-putting
- A bit more syrupy/runny than I like, I want to be able to put it on a cracker without dripping
- Too sweet
- I thought it was more syrupy than most jellies and was a tad too sweet
- It is not a jam, not a jelly. It's in the in between
- A little too sweet, also too runny. It has an almost candy-like feel, where I would feel bad if I ate a lot.
- It would be better if the mouthfeel was more consistent. The lumpy clumps feel weird in my mouth.

Other Comments:

- Amazing product overall!
- Thank you!
- Better than any jelly I've ever had. Smells like sugar!

### 3. Formal Sensory Survey (UCD Coffee Center Site Dedication Event 6/25/21)

*Survey was distributed through a QR code at the sampling booth. Paper surveys were offered as well in the following format:*

#### **Cascara Jelly Sensory Survey**

**Cascara Jelly Ingredients:** organic cascara juice, demerara sugar, water, lemon juice, lemon pectin

Sample batches made on: 6/23/21

**Taste-testing instructions:** Please taste one spoonful of the jelly sample indicated on the survey (201, 978, 365) alone or on a cracker. Drink water and/or eat a cracker in between each sample. You may taste the sample again throughout the survey if necessary. Answer the following questions:

#### Liking

What is your OVERALL OPINION of the sample? (Mark the box you choose):

Extremely Dislike	Dislike Very Much	Moderately Dislike	Slightly Dislike	Neither Like nor Dislike	Slightly Like	Moderately Like	Like Very Much	Extremely Like
-------------------	-------------------	--------------------	------------------	--------------------------	---------------	-----------------	----------------	----------------

How much do you like or dislike the APPEARANCE of the sample? (Mark the box you choose):

Extremely Dislike	Dislike Very Much	Moderately Dislike	Slightly Dislike	Neither Like nor Dislike	Slightly Like	Moderately Like	Like Very Much	Extremely Like
-------------------	-------------------	--------------------	------------------	--------------------------	---------------	-----------------	----------------	----------------

How much do you like or dislike the FLAVOR of the sample? (Mark the box you choose):

Extremely Dislike	Dislike Very Much	Moderately Dislike	Slightly Dislike	Neither Like nor Dislike	Slightly Like	Moderately Like	Like Very Much	Extremely Like
-------------------	-------------------	--------------------	------------------	--------------------------	---------------	-----------------	----------------	----------------

How much do you like or dislike the MOUTHFEEL of the sample? (Mark the box you choose):

Extremely Dislike	Dislike Very Much	Moderately Dislike	Slightly Dislike	Neither Like nor Dislike	Slightly Like	Moderately Like	Like Very Much	Extremely Like
-------------------	-------------------	--------------------	------------------	--------------------------	---------------	-----------------	----------------	----------------

#### Adequacy of Select Attributes

**Flavor** – Please indicate how you feel about the flavor of the jelly sample (Mark the box you choose):

Much Too Weak	Somewhat Too Weak	Just About Right	Somewhat Too Strong	Much Too Strong
---------------	-------------------	------------------	---------------------	-----------------

**Acidity** - Please indicate how you feel about the acidity of the sample (Mark the box you choose):

Much Too Low	Somewhat Too Low	Just About Right	Somewhat Too High	Much Too High
--------------	------------------	------------------	-------------------	---------------

**Sweetness** - Please indicate how you feel about the sweetness of the sample (Mark the box you choose):

Much Too Low	Somewhat Too Low	Just About Right	Somewhat Too High	Much Too High
--------------	------------------	------------------	-------------------	---------------

**Consistency** - Indicate how you feel about the consistency of the sample (Mark the box you choose):

Much Too Thin/Runny	Somewhat Too Thin/Runny	Just About Right	Somewhat Too Thick/Gelled	Much Too Thick/Gelled
---------------------	-------------------------	------------------	---------------------------	-----------------------

### Description of the Jelly

From the list of attributes/features in each category below, mark all boxes that apply to the sample:

#### **Flavor (Aroma, Taste & Trigeminal)**

Fig	Apple	Raisin	Honey
Citrus	Plum	White Sugar	Vegetal
Red Berry	Grape	Caramel/Brown Sugar	Floral
Cherry	Date	Molasses	Earthy
Stone Fruit	Dried Fruit	Maple	<b>Other:</b>

#### **Body/Mouthfeel**

Smooth	Viscous	Thin	<b>Other:</b>
Grainy	Sticky	Syrupy	
Clumpy	Gelatinous	Thick	

#### **Holistic/Hedonic**

Aromatic	Balanced/Blended	Bland/Flat	Complex	<b>Other:</b>
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#### **Defects**

Rancid/Rotten	Fermented	Burnt	Medicinal	<b>Other:</b>
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#### Open Comments

What specifically did you **like** about this jelly:

What specifically did you **dislike** about this jelly:

Other Comments:

#### **4. Sensory Survey Consent Form**

**University of California, Davis**

#### **INFORMED CONSENT FORM FOR PARTICIPATING IN: Sensory Evaluation and Marketing Research**

**Title of study: Potential Economic & Environmental Benefits of Upcycling Coffee Byproducts: A Feasibility Study of Cascara Jelly Production on Smallholder Farms in Huehuetenango, Guatemala and Negros, Philippines.**

**Investigators:** Melina Devoney and Timothy Buensalido

#### **Introduction and Purpose**

You are being invited to join a research study of cascara jelly sensory and marketing evaluation. The purpose of this study is to determine the feasibility of cascara jelly production for smallholder farmers in Huehuetenango, Guatemala and Negros, Philippines.

If you agree to participate in this research, you will be asked to taste cascara jelly samples and complete a survey. The survey includes questions about the samples and about your thoughts on cascara jelly and similar products. It will take about 10 minutes to complete the survey.



## Benefits and Risks

There is no direct benefit to you from taking part in this study. We hope that the research will share insight on the potential of upcycling some waste generated during coffee production, increasing farmer income and lessening environmental impacts of cascara waste.

The risks of this research are minimal. If you have prior experience of any allergic reactions to any of the cascara jelly ingredients, you should not participate in this study. If you experience allergic reactions any time during the study, you should discontinue the study. Cascara jelly may contain caffeine. Other ingredients of the cascara jelly are listed here and on the survey: organic cascara juice, demerara sugar, water, lemon juice, lemon pectin.

You may skip any of the survey questions you do not want to answer. You are free to withdraw from the study at any time and for any reason. We also reserve the rights to terminate your participation of the study at any time and for any reason.

## Confidentiality

As with all research, there is a chance that confidentiality could be compromised; however, we are taking precautions to minimize this risk. Your responses to the survey questions will not include information that identifies you. However, individuals from UC Davis who oversee research may access your data during audits or other monitoring activities.

To minimize the risks of breach of confidentiality, we will not ask questions that identifies participants' identity. Data collected will be accessed only by principal researchers and immediate major professors overseeing the project.

## Compensation

You will not be paid for taking part in this study.

## Rights

***Participation in research is completely voluntary.*** You are free to decline to take part in the project. You can decline to answer any questions and you can stop taking part in the project at any time. Whether or not you choose to participate, or answer any question, or stop participating in the project, there will be no penalty to you or loss of benefits to which you are otherwise entitled.

## Questions

If you have any questions about this research, please feel free to contact the investigators at +1 213-804-0231/ +1 443-642-1464 or [mldevoney@ucdavis.edu](mailto:mldevoney@ucdavis.edu)/[timbuensalido@ucdavis.edu](mailto:timbuensalido@ucdavis.edu).

If you have any questions about your rights or treatment as a research participant in this study, please contact the University of California Davis, Institutional Review Board at 916-703-9158 or [HS-IRBEducation@ucdavis.edu](mailto:HS-IRBEducation@ucdavis.edu).

### ***Consent for adult participants (over 18 years old)***

*I have read and understand the above information and voluntarily consent to participate in this study. I have been given a copy of this consent form.*

---

Name (Print)

---

Signature

---

Date

### ***Parental/Guardian consent (for children under 18 years old).***

*I have read and understand the above consent form and voluntarily agree that my child may participate in this study.*

---

Parent/Guardian Name (Print)

---

Parent/Guardian Signature

---

Date

## **5. Farmer Feasibility Study**

**University of California, Davis**

### **INFORMED CONSENT FORM FOR PARTICIPATING IN: Feasibility Survey**

**Title of study: Potential Economic & Environmental Benefits of Upcycling Coffee Byproducts: A Feasibility Study of Cascara Jelly Production on Smallholder Farms in Huehuetenango, Guatemala and Negros, Philippines.**

**Investigators:** Melina Devoney and Timothy Buensalido

#### **Introduction and Purpose**

You are being invited to join a research study on the production of coffee husk jelly. The objective of this study is to determine the viability of shell jelly production for families of small farmers in Negros, Philippines.

If you agree to participate in this research, you will be asked to imagine that you will produce the peel jelly described in the recipe provided. You will be asked to estimate the costs of ingredients and equipment, and the ease with which you could purchase them.

Next, you will be asked to complete a feasibility survey that includes questions about your opinion of shell jelly. The survey will take approximately 10 minutes. You will be asked to distribute the survey to as many workers in the coffee sector who wish to participate. Each participant will have to read and sign a consent form before completing the survey.

#### **Benefits and Risks**

The direct benefit to you from participating in this study is a wage of P700 per hour. The money will be sent directly to you electronically through Xoom (a wire transfer method). You are allowed to use this recipe for whatever purpose you choose as it is not proprietary.

The risks of this research are minimal. You can skip any of the survey questions that you do not want to answer. You are free to withdraw from the study at any time and for any reason. We also reserve the right to terminate your participation in the study at any time and for any reason.

Importantly, your responses to the survey regarding your ability and desire to make the cascara jelly will NOT affect your compensation, nor will it compromise the success of this study. We

hope that your cooperation will provide information on the recycling potential of residues generated during coffee production to increase farmers' income and decrease the environmental impacts of husk residues in your community, so we want the data on the successes and jelly production failures are accurate.

### **Confidentiality**

As with all research, there is a chance that confidentiality could be compromised; however, we are taking precautions to minimize this risk. Your responses to the survey questions will not include information that identifies you. However, individuals from UC Davis who oversee research may access your data during audits or other monitoring activities.

To minimize the risks of breach of confidentiality, we will not ask questions that identifies participants' identity. Data collected will be accessed only by principal researchers and immediate major professors overseeing the project.

### **Compensation**

You will not be paid for taking part in this study.

### **Rights**

***Participation in research is completely voluntary.*** You are free to decline to take part in the project. You can decline to answer any questions and you can stop taking part in the project at any time. Whether or not you choose to participate, or answer any question, or stop participating in the project, there will be no penalty to you or loss of benefits to which you are otherwise entitled.

### **Questions**

If you have any questions about this research, please feel free to contact the investigators at +1 213-804-0231/ +1 443-642-1464 or [mldevoney@ucdavis.edu](mailto:mldevoney@ucdavis.edu)/[timbuensalido@ucdavis.edu](mailto:timbuensalido@ucdavis.edu).

If you have any questions about your rights or treatment as a research participant in this study, please contact the University of California Davis, Institutional Review Board at 916-703-9158 or [HS-IRBEducation@ucdavis.edu](mailto:HS-IRBEducation@ucdavis.edu).

### ***Consent for adult participants (over 18 years old)***

*I have read and understand the above information and voluntarily consent to participate in this study. I have been given a copy of this consent form.*

---

Name (Print)

---

Signature

---

Date

***Parental/Guardian consent (for children under 18 years old).***

*I have read and understand the above consent form and voluntarily agree that my child may participate in this study.*

---

Parent/Guardian Name (Print)

---

Parent/Guardian Signature

---

Date

**5.a. Key Informant Informed Consent**

**University of California, Davis**

**INFORMED CONSENT FORM FOR PARTICIPATING IN:  
Feasibility Survey**

**Title of study: Potential Economic & Environmental Benefits of Upcycling Coffee Byproducts: A Feasibility Study of Cascara Jelly Production on Smallholder Farms in Huehuetenango, Guatemala and Negros, Philippines.**

**Investigators:** Melina Devoney and Timothy Buensalido

**Introduction and Purpose**

You are being invited to join a research study on the production of coffee fruit jelly. The purpose of this study is to determine the viability of cascara jelly production for families of small farmers in Negros, Philippines.

If you agree to participate in this research, you will be asked to imagine that you will make the cascara jelly as described in the recipe provided. Next, you will be asked to complete a feasibility survey that includes questions about your opinion of cascara jelly. The survey will take approximately 15 minutes.

## **Benefits and Risks**

The direct benefit to you from participating in this study is a one-time payment of P500 in cash disbursed to you by the survey distributor. You are allowed to use this recipe for whatever purpose you choose as it is not proprietary.

The risks of this research are minimal. You can skip any of the survey questions that you do not want to answer. You are free to withdraw from the study at any time and for any reason. We also reserve the right to terminate your participation in the study at any time and for any reason.

Importantly, your responses to the survey regarding your ability and desire to make the cascara jelly will NOT affect your compensation, nor will it compromise the success of this feasibility study. We hope that your participation will provide information on the recycling potential of residues generated during coffee production to increase farmers' income and decrease the environmental impacts of husk residues in your community. Therefore, we want the data on the successes and failures of jelly production to be accurate.

## **Confidentiality**

As with all research, there is a chance that confidentiality could be compromised; however, we are taking precautions to minimize this risk. Your responses to the survey questions will not include information that identifies you. However, individuals from UC Davis who oversee research may access your data during audits or other monitoring activities.

To minimize the risks of breach of confidentiality, we will not ask questions that identifies participants' identity. Data collected will be accessed only by principal researchers and immediate major professors overseeing the project.

## **Compensation**

You will not be paid for taking part in this study.

## **Rights**

***Participation in research is completely voluntary.*** You are free to decline to take part in the project. You can decline to answer any questions and you can stop taking part in the project at any time. Whether or not you choose to participate, or answer any question, or stop participating in the project, there will be no penalty to you or loss of benefits to which you are otherwise entitled.

## **Questions**

If you have any questions about this research, please feel free to contact the investigators at +1 213-804-0231/ +1 443-642-1464 or [mldevoney@ucdavis.edu](mailto:mldevoney@ucdavis.edu)/[timbuensalido@ucdavis.edu](mailto:timbuensalido@ucdavis.edu).

If you have any questions about your rights or treatment as a research participant in this study, please contact the University of California Davis, Institutional Review Board at 916-703-9158 or [HS-IRBEducation@ucdavis.edu](mailto:HS-IRBEducation@ucdavis.edu).

***Consent for adult participants (over 18 years old)***

*I have read and understand the above information and voluntarily consent to participate in this study. I have been given a copy of this consent form.*

\_\_\_\_\_  
Name (Print)

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Date

***Parental/Guardian consent (for children under 18 years old).***

*I have read and understand the above consent form and voluntarily agree that my child may participate in this study.*

\_\_\_\_\_  
Parent/Guardian Name (Print)

\_\_\_\_\_  
Parent/Guardian Signature

\_\_\_\_\_  
Date

**5.b. Farmer Feasibility Survey**

**Coffee Jelly Feasibility Survey**

Thank you so much for participating! Your honest answers will be of much help for our investigation.

1. What is your occupation? *Mark all that apply:*

☐Coffee grower (my main crop is coffee)

☐Farmer (my main crop is not coffee)

☐Coffee Roaster

☐Coffee Processor

☐Other (describe here): \_\_\_\_\_

2. Are you a member of any cooperative?

☐ Yes (name it here): \_\_\_\_\_

☐ No

3. How large is the area of the farm / facility that you own or work on (specific dimensions or general description)?

4. What is your role in this farm / facility?

☐ I am the owner

☐ I am an employee

☐ Volunteer helper or apprentice (I work without pay)

☐ Other (describe): \_\_\_\_\_

5. How many people work in that farm / facility?

☐ Less than 5

☐ 5 – 10

☐ 10 – 50

☐ 50 -100

☐ More than 100

6. Considering the recipe for the jelly, Would you consider producing this jelly in your home / farm / facility? *Mark all that apply:*

☐ Yes, for my family

☐ Yes, to sell locally

☐ Yes, to export

☐ No (please explain in the following questions)

7. Where would you cook the jelly? *Mark all that apply:*

☐ A house

☐ A farm

☐ A facility (explain): \_\_\_\_\_

☐ A cooperative (name it): \_\_\_\_\_

☐ Other (explain): \_\_\_\_\_



8. How many people in that farm / facility would potentially be able to help make the shell jelly?
- ☐ Less than de 5                      ☐ 5 – 10                      ☐ 10 – 50                      ☐ 50 -100                      ☐ More than 100
9. How clear and precise is this recipe?
- ☐ Everything is easy to follow and understand
- ☐ Some steps are not clear or they are hard to understand
- ☐ The majority of the steps are not clear or are hard to understand.
10. If it applies, which steps in the jelly recipe do you think are hard to follow?
11. What problems do you think you will face with this recipe?
12. How much time would you have in a typical work day to make this jelly? (with or without the help of others)?
13. How would you adapt this recipe to make it more feasible for yourself?
14. Do you have access to enough clean water to perform all the washing/sterilizing steps in the recipe? *Mark all that apply:*
- ☐ Yes, at home
- ☐ Yes, in the farm
- ☐ Yes, in the facility
- ☐ Yes, in the cooperative
- ☐ No
15. What by-products or waste could this recipe generate?
16. What are you currently doing with your coffee pulp leftovers? *Mark all that apply:*
- ☐ Mixing it in a compost for agricultural use
- ☐ Toss in vacant land
- ☐ Toss in water

☐Cattle Feed

☐Does not apply

☐ Other: \_\_\_\_\_

17. What information would you need to decide if you would consider making jelly from the shell instead of continuing what you are currently doing with the shell?
18. If this process yields additional income, how much time a week/month would you be willing to spend on it?
19. Do you have other goods you work with outside of coffee? If yes, what else?
20. How long does it take to go to and from the coffee farm/facility?
21. How many days a week do you work with coffee?
22. How many hours a day on average makes a workday?
23. How many months a year do you work with coffee? What months?
24. What do you do on months that you do not work with coffee?
25. What are some of the tasks you do in relation to coffee? (anything from planting to packing)
26. What type of tools, inputs, or equipment do you need, and how much do they cost? How often do they need to be replaced?
27. Other than green or parchment coffee, what else do you sell?
28. How much raw coffee beans are harvested and processed? How much green/parchment coffee do you end up with?
29. How much do you sell green or parchment coffee per lb or kg? (range)
30. How do you decide on the price you charge for coffee?
31. Who do you sell to? How much do they buy? How often do they buy it?
32. Outside of work, what are some other responsibilities you attend to? How many hours a day is this? How many hours a day do you sleep?

33. Are the following ingredients accessible in your area? (yes/no per line)

- a. Citrus juice (lemon, calamansi, or lime)
- b. Pectin (lemon, calamansi, or lime)
- c. Sugar
- d. Coffee cherries
- e. Water

34. Are the following tools and equipment accessible in your area?

- a. Pots
- b. Pans
- c. Measuring cups/spoons
- d. Mason jars/glass jars
- e. Strainer
- f. Whisk
- g. Stove

**Demographic Questions:** You can leave answers blank if you do not feel comfortable:

Indicate sex:

☐Female      ☐Male      ☐Other: \_\_\_\_\_

Indicate your age:

☐Younger than 18      ☐18-24      ☐25-34      ☐35-44      ☐45-54      ☐55-64      ☐65+

In what region of Negros do you live?

Please indicate your highest level of education completed:

☐None      ☐Elementary      ☐Secondary  
☐Some college / professional school      ☐College degree / profesional  
☐Graduate Degree      ☐I prefer not to answer

Number of people in household?

\_\_\_ Children \_\_\_ Adults

Monthly/Annual Income?

Main source of income?

Monthly/Annual expenses?

## 6. Total Fixed Costs

<b>Total Fixed Costs</b>	<b>Philippine pesos</b>
Large (~10L) non-reactive pot w/ lid (stainless steel)	300
Medium non-reactive bowl (stainless steel, glass, enamel-coated)	40
Cheese cloth/fine metal strainer	20
Spatula	50
Tongs	100
Timer	150
Vegetable peeler	20
Food scale	150
Dish soap	30
Measuring cups and spoons	100
Isopropyl alcohol	50
Metal fork and spoon	10/set
Clear cup (glass or plastic)	5
Marker	10
Tape/label	10
Candy Thermometer	80
<b>Total</b>	<b>1,125PhP</b>

## 7. IRB Approval



OFFICE OF RESEARCH  
IRB Administration  
TELEPHONE: 916 703-9151

SACRAMENTO, CALIFORNIA 95817

June 21, 2021

Jim Hill, PhD  
Department: Plant Sciences  
Phone: 530-752-3458  
Email: jehill@ucdavis.edu

On June 21, 2021 the UC Davis IRB reviewed the following protocol:

Type of Review:	New Project
Title:	Cascara Jelly, Jams, Syrup & Beverages
Investigator:	Hill, Jim, PhD
IRB ID:	1768032-1
Funding:	Department
Grant ID and Title:	None
IND, IDE or HDE:	N/A
Documents Submitted:	<ul style="list-style-type: none"><li>• Advertisement - Cascara Jelly Recruitment Material.docx</li><li>• Application Form - IRB form.pdf</li><li>• Consent Form - HRP-502-Consent-for-Survey-Interview-Research Devoney and Buensalido.docx</li><li>• Protocol - HRP-503-TEMPLATE-PROTOCOL-Surveys-Questionnaires-Focus-Groups-Observations Devoney and Buensalido.docx</li><li>• Questionnaire/Survey - Cascara Jelly Liking Survey.docx</li><li>• Questionnaire/Survey - Cascara Jelly Farmer Survey-Interview.docx</li><li>• Questionnaire/Survey - Cascara Jelly Tasting Survey.docx</li><li>• UC Davis - Initial Review Application</li></ul>

Determination:	Exempt [2]
Comments/Conditions:	<p>This determination applies only to the activities described in the IRB submission and does not apply should any changes be made. If changes are being considered and there are questions about whether IRB review is needed, please submit a modification request to the IRB for another determination.</p> <p>In conducting this protocol you are required to follow the requirements listed in the INVESTIGATOR MANUAL (HRP-103).</p>

This Assurance, on file with the Department of Health and Human Services, covers this determination:

FWA No: 00004557  
Expiration Date: January 05, 2024  
IORG: 0000251

