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Department of Agribusiness Management

Agribusiness Management



Special Graduation Project

**Development of a strategic plan for wood charcoal exportation
from the Carbonera Buenos Aires company, Oratorio, Santa Rosa,
Guatemala**

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Abstract

Carbonera Buenos Aires began producing wood charcoal in 2021 in Oratorio, Santa Rosa, Guatemala, targeting the "La Terminal" retail market in Guatemala City. The company saw a market opportunity in wood charcoal and now sells 9.09 tons weekly at competitive prices. The raw material, Guatemalan Oak, is sourced from Jutiapa and Santa Rosa. The company's strategic location, good roads, and sufficient area for expansion support its operations. Using handmade ovens and a workforce of five, the charcoal production process takes one week, ensuring high quality. CEO Jorge Molina is exploring export opportunities for higher profit margins despite a strong local market presence. A market study identified the USA as a viable export market due to favorable logistics and profitability. Although the company currently has no US clients, a scenario was developed assuming a standard export price and considering key variables like export price and local production. The project compared the financial viability of local sales versus exports using financial indicators such as Net Present Value (NPV) and Internal Rate of Return (IRR). The analysis showed better financial outcomes for exporting. Additionally, risk software @risk was used to estimate the probability of achieving the projected financial indicators. The results indicated a 72.2% probability of higher profits from exporting over a 10-year projection, based on 50,000 possible scenarios. This (Indexbox, 12/27/2022) suggests that expanding into the export market is a favorable option for Carbonera Buenos Aires.

Keywords: financial indicators, wood charcoal, retail market, export, risk.

Resumen

Carbonera Buenos Aires comenzó a producir carbón de leña en 2021 en Oratorio, Santa Rosa, Guatemala, dirigiéndose al mercado minorista "La Terminal" en la Ciudad de Guatemala. La empresa vio una oportunidad de mercado en el carbón de leña y ahora vende 9,09 toneladas semanales a precios competitivos. La materia prima, roble guatemalteco, se obtiene de Jutiapa y Santa Rosa. La ubicación estratégica de la empresa, las buenas carreteras y un área suficiente para la expansión apoyan sus operaciones. Utilizando hornos artesanales y una fuerza laboral de cinco personas, el proceso de producción de carbón tarda una semana, garantizando alta calidad. A pesar de su fuerte presencia en el mercado local, el CEO Jorge Molina está explorando oportunidades de exportación para obtener márgenes de ganancia más altos. Un estudio de mercado identificó a Estados Unidos como un mercado de exportación viable debido a la logística favorable y la rentabilidad. Aunque la empresa actualmente no tiene clientes en Estados Unidos, se desarrolló un escenario asumiendo un precio de exportación estándar y considerando variables clave como el precio de exportación y la producción local. El proyecto comparó la viabilidad financiera de las ventas locales frente a las exportaciones utilizando indicadores financieros como el Valor Presente Neto (VPN) y la Tasa Interna de Retorno (TIR). El análisis mostró mejores resultados financieros para la exportación. Además, se utilizó el software de riesgo @risk para estimar la probabilidad de alcanzar los indicadores financieros proyectados. Los resultados indicaron una probabilidad del 72.2% de obtener mayores ganancias con la exportación durante una proyección de 10 años, basada en 50,000 escenarios posibles. Esto sugiere que expandirse al mercado de exportación es una opción favorable para Carbonera Buenos Aires.

Palabras clave: indicadores financieros, carbón vegetal, mercado minorista, exportación, riesgo.

Introduction

Charcoal, a carbon-rich fuel derived from wood, is characterized by its porous, solid, and brittle nature. Its heating power makes it an option commonly used in ovens, barbecues, and campfires, (Barbarán, 2019). Wood charcoal is produced in different ways, including mountain holes, mountain ovens, handcrafted, and industrial ovens. Specifically, at the San Antonio Buenos Aires farm, charcoal production is carried out using artisanal ovens.

In Guatemala, charcoal exportation has historically contributed significant income for the country, however, the focus production for the local market demand, forced the import of this product to be carried out. In 2011, exports reached \$260,000 whereas imports stood at \$72,000. According to reports from the National Forest Institute, the local production area has been decreasing over the years. In 1999, the forest area designated for charcoal production decreased from 184,000 cubic meters to 73,000 cubic meters in 2000.

Presently, wood charcoal is a product with high consumption in many countries worldwide, particularly in industrial processes that require heat during their production chain. Its advantageous properties have positioned it as an indispensable resource for various industries. Another common use of wood charcoal is as a popular heating fuel for barbecues and recipes from culinary disciplines, where most of the time this food is considered more expensive and exquisite, allowing customers of wood charcoal to generate higher revenue.

The importance of wood charcoal in society is evident in its role in job creation, both direct and indirect jobs, encompassing labor in production areas, transportation, packaging, and exportation, contributing to rural development by providing salaries to local workers. The connection that this topic has with research focuses on developing a strategic plan so that this product can have a greater reach in market areas, reaching an export level, for producing charcoal at the San Antonio Buenos Aires estate, Oratorio, Santa Rosa.

Charcoal, derived from sustainably managed forests, presents an attractive opportunity due to the growing interest in eco-friendly alternatives to traditional fuels. The San Antonio Buenos Aires farm, with its infrastructure and expertise in artisanal production, is well-positioned to capitalize on this demand. By modernizing production techniques, implementing sustainable practices, and establishing strategic partnerships, the farm can increase its revenue and contribute to environmental preservation and rural development, (Padilla, 2013). The main objective consisted of developing a strategic plan for the successful expansion of the charcoal production and marketing business of the family company from Oratorio, Santa Rosa, towards the export market. Analyze international charcoal markets, identifying relevant demands, regulations, and trends to establish a solid understanding of the export landscape. The specific objectives state the following: Evaluate the current financial structure of the charcoal production and marketing business, carrying out a financial analysis that allows determining the economic viability and the necessary resources for expansion towards export. Design a strategic plan that contemplates adapting production, distribution, and quality processes to comply with international standards and export regulations, ensuring product consistency and quality. Perform a comprehensive risk analysis that identifies possible obstacles and challenges that could arise during export expansion, and propose mitigation measures and contingency plans to guarantee business continuity and minimize possible negative impacts.

The Carbonera Buenos Aires company focuses on wood charcoal production for commercialization, mainly to wholesale clients responsible for supplying markets in Guatemala City. The company's demand directly hinges on these wholesalers, who pay fixed rates for all delivered production. To increase the company's income and diversify its sources of income, Carbonera Buenos Aires contemplates venturing into product exportation. Wood charcoal is sold at the moment as a commodity, but the company intends to give it added value, and one of the contemplated is the creation of a package for the company's brand, and evaluating the viability of entering new markets for exportation and thus increasing economic benefits. The relevance of this topic lies in its practical

application and potential for growth and success. The Carbonera Buenos Aires company exists, and this document aims to develop a method with theoretical foundations to pave the way for the company's future international commercialization and exportation of wood charcoal. This business-oriented approach to solving a real business challenge stands out as the importance of the proposed investigation. The company faces a concrete necessity to diversify its markets and add aggregated value, which can have a significant impact on its economic growth and the creation of employment in the region.

The project seeks to develop a methodology tailored to the company's reality. The aim is to develop the methodological framework, and once approved, apply it to the company to increase economic benefits through expansion towards international commercialization and exportation. Limitations inherent in the project are the limited export experience and market knowledge. These limitations serve as catalysts for the development of this project and the opportunity for the company. This project, centers on the transition of a business with local commercialization to export, and has the potential to generate an impact on other businesses that are in a similar position, in the process of economic improvement, serving as a reference for the future market, export, or other kinds of research, offering a paper of a practical and realistic route. Likewise, this project could contribute new perspectives to the Carbonera Buenos Aires, where domestic sales currently predominate.

Charcoal is a product derived from trees, formed thanks to a process called pyrolysis, which is defined as a thermal decomposition process in which organic matter is decomposed into its basic components by heat in the absence of oxygen, (Extínguelo, 2023). "For several centuries charcoal has been used as a cooking fuel. Its characteristics are the absence of smoke and its lightweight (Abascal, 2011)." The Guatemalan market for wood-derived products has a significant economic impact, with imports totaling \$130 million and exports reaching \$146 million in 2021. The exports were distributed mainly towards the United States (\$63.4M), Honduras (\$21.5M), El Salvador (\$18.2M), China (\$6.44M), and The Bahamas (\$5.85M); according to (The Observatory of Economic Complexity, 2022).

Methodology

The research focus is to determine how the Carbonera Buenos Aires company can expand its market and successfully venture into exportation. The investigation design is non-experimental. The type of investigation is qualitative exploratory, and it has a convenient sampling. The population is comprised of some companies who already engaged in wood charcoal exportation and the sampling, since it is a convenient type, includes selected companies with production and market characteristics similar to those of Carbonera Buenos Aires. The collected information was extracted from reliable websites and thesis projects from Zamorano students.

The following information stands for the methodology used in each goal to achieve it successfully.

1st goal: “Develop a strategic plan for the successful expansion of the charcoal production and marketing business of the company from Oratorio, Santa Rosa, towards the export market.” To achieve this goal, a sequence of steps would be followed.

Market Research and Analysis

Conduct market research to identify target export markets for wood charcoal, considering factors such as demand trends, regulatory requirements, and competitive landscape. Analyze market data and industry reports to assess market potential and identify expansion opportunities. Gather insights from interviews with industry experts, potential customers, and key stakeholders to understand market dynamics and preferences. Information could be collected by making use of web access, phone calls, online surveys to gather data faster, interviews focusing on groups of people to explore their opinions, analyzing reports, researching case studies and experiments, and searching for trends in social media.

SWOT Analysis

Perform a SWOT (Strengths, Weaknesses, Opportunities, Threats) analysis of the company's current charcoal production and marketing business, focusing on internal strengths and weaknesses as well as external opportunities and threats related to exportation.

Identify internal capabilities and resources that can be leveraged to support export expansion.

Strategic Planning

Develop a strategic plan outlining specific objectives, strategies, and action plans for expanding the company's charcoal production and marketing business into export markets.

2nd goal: "Analyze international charcoal markets, identifying relevant demands, regulations, and trends to establish a solid understanding of the export landscape."

Market Research

Research international charcoal markets to identify key demand drivers, market trends, and regulatory requirements.

Utilize a combination of primary and secondary research methods, including industry reports and market surveys.

Demand Analysis

Analyze demand dynamics for wood charcoal in target export markets, considering factors such as consumer preferences, consumption patterns, and market segmentation. Identify specific market segments or niche markets with high demand potential for wood charcoal products.

Regulatory Assessment

Investigate regulatory frameworks and import/export regulations governing the trade of wood charcoal in target export markets. Evaluate compliance requirements, certification standards, and documentation procedures for exporting wood charcoal products to ensure adherence to international trade regulations.

Investigate the countries with more imports of wood charcoal and compare the prices in each country. Around the globe, out of 100% imports, the countries with more contribution are Japan with 6.83%, Saudi Arabia with 5.6%, and the USA with 4.9% (Statista, 2023). The prices of imports within these countries are \$ 869.00 per ton in Japan (Indexbox, 12/31/2023), \$ 774.00 per ton in Saudi Arabia (Kanbkam, 2024), and \$ 895.00 per ton in the USA (Indexbox, 2024). Select the possible target country to export by choosing the one with better payments for the product.

Considering the top markets, the USA was selected as the target country since it is near Guatemala and has better possibilities for accepting the product.

Evaluate the profitability of developing the exportation to the country, if the margin of income is low, select another country. The company has a selling price of \$ 662.82 per ton of wood charcoal, meanwhile, in the USA the import price is \$ 895.00 per ton. This demonstrates that exporting is better with an average reason of \$ 227.18 per ton of difference rather than selling locally. With the relevant demand selected, identify the regulations and trends that involve the demand.

3rd goal: "Evaluate the current financial structure of the charcoal production and marketing business, carrying out a financial analysis that allows determining the economic viability and the necessary resources for expansion towards export."

Data Collection

Gather financial data related to the charcoal production and marketing business, including revenue, expenses, profit margins, and investment expenditures. Collect information on production costs, distribution expenses, marketing budgets, and any other relevant financial metrics associated with the company's operations.

Cost-Benefit Analysis

Compare the projected costs of export market entry, including investment in production capacity, packaging, marketing, and distribution, against the expected benefits in terms of increased revenue, market share, and profitability.

Financial Modeling

Develop financial models and projections to estimate the potential financial outcomes of the export expansion strategy over different time horizons. Incorporate key variables, assumptions, and sensitivities into the financial models to assess their impact on profitability and cash flow generation. Determine the direct and indirect costs that the company would incur at the moment of beginning to export.

Table 1

Direct and Indirect Costs when exporting

Direct	Indirect
Production	Certification
Transportation	Regulatory compliance
Port costs	Marketing costs
Documentation	Fees and customs duties
Legal expenses	Variations in the exchange rate

Evaluate the viability of the wood charcoal export by comparing the projected income against total costs. The projected income is \$ 895.00 per ton of wood charcoal since it is the medium price of importation that the USA is paying. Analyze the viability result and consider if is worth export in the selected market.

4th goal: “Design a strategic plan that contemplates adapting production, distribution, and quality processes to comply with international standards and export regulations, ensuring product consistency and quality.”

International Standards and Regulations

Research international standards and regulations governing charcoal production, packaging, distribution, and quality control in target export markets. Identify regulatory requirements, certification standards, and industry best practices related to product specifications, labeling, packaging materials, and quality assurance protocols.

Gap Analysis

Perform a gap analysis to assess the current production, packaging, distribution, and quality control processes of the company against international standards and export regulations.

Process Mapping

Map out the company's existing production, packaging, distribution, and quality control processes to understand workflow, resource allocation, and process dependencies.

Strategic Plan Development

Develop a strategic plan outlining specific initiatives and action steps to adapt production, packaging, distribution, and quality processes to comply with international standards and regulations. Investigate the global standards for wood charcoal and its exportation regulations. Create a strategic plan to adapt the company's production to an export expansion by considering the rules and standards required to export.

5th goal: "Conduct a risk analysis that identifies possible obstacles and challenges that could arise during export expansion and propose mitigation measures and contingency plans to guarantee business continuity and minimize possible negative impacts."

Creation Of The Simulation Model

A simulation model was developed in Excel to reflect the financial analysis of the charcoal export project. This model includes key variables related to exportation, such as production costs, selling prices, transportation, and logistics expenses, among others.

Identification Of Uncertain Variables

Uncertain variables in the context of charcoal exportation were identified. These variables may include selling prices, international transportation costs, and charcoal demand. Each variable was assigned an appropriate probability distribution, such as normal distributions or other relevant distributions.

Definition Of Financial Indicators

Key financial indicators to evaluate the economic viability of the project were determined. These indicators include Net Present Value (NPV), Internal Rate of Return (IRR), Payback Period, and Profitability Index (PI).

Monte Carlo Simulation

The @Risk software was used to perform a Monte Carlo simulation. This simulation generated 10,000 possible scenarios for the simulation model, considering the probability distributions of uncertain variables. For each generated scenario, the previously defined financial indicators were calculated. Determine possible risks at the moment of expansion to the export market by using a Vester matrix, based on the frequent risks from other companies who export wood charcoal. Considering the most important risks, realize a plan to mitigate them efficiently to reduce any possibility of increasing costs and affect production as much as possible.

Results and Discussion

Technical Study Of Charcoal Production

Project Location

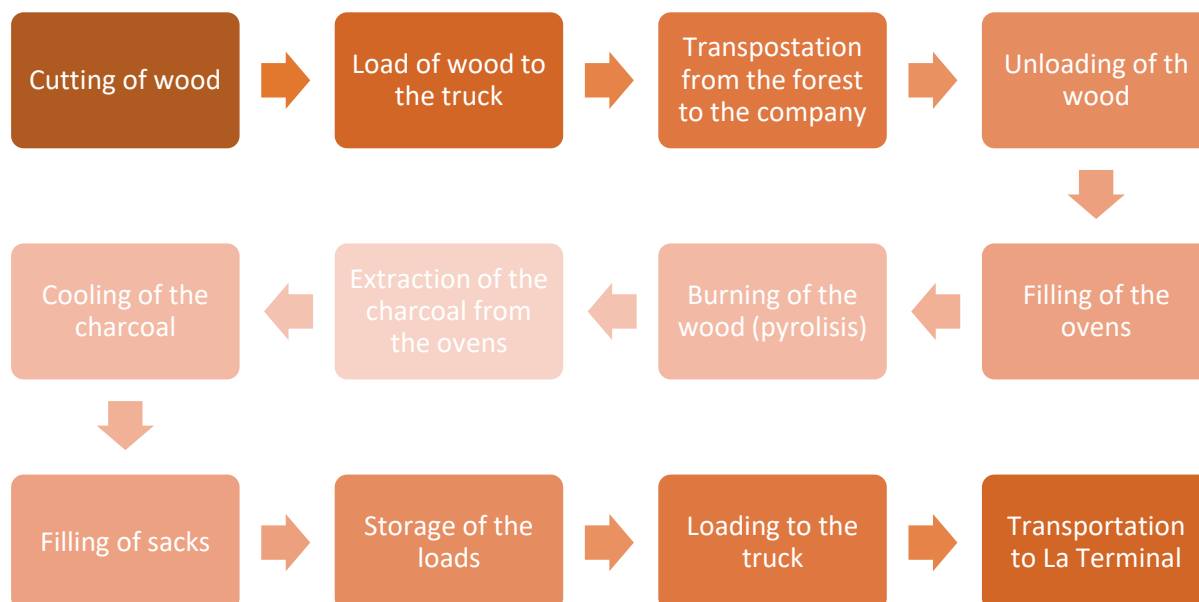
Carbonera Buenos Aires company is located approximately 2.5 hours by car from Guatemala City, the country's capital. It is also located an estimated 5 to 6 hours by car from the port of Izabal. This strategic location allows efficient access from the main urban center of Guatemala and the port region of the Guatemalan Caribbean.

Project Engineering

Buenos Aires Farm has a total productive area of 20 hectares, of which only 1 hectare is in use, where there are 11 artisanal ovens. On the other hand, the area has a warehouse, where 2 buckets, 2 barrels (200 liters), 2 carts, and 3 axes are stored, it has electricity, availability of municipal drinking water, and a house for employees. The farm pays transportation to an external company, which carries out the transfer of the product from the farm to the desired destination.

Figure 1

Flow Process

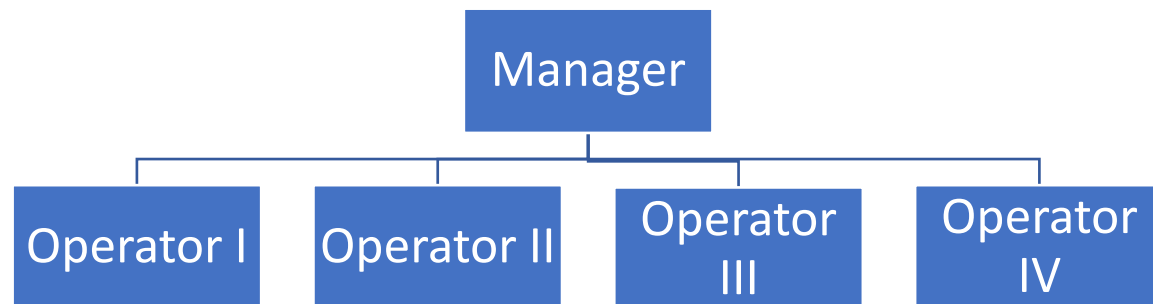


For the company to elaborate wood charcoal, a series of steps have to be followed as shown in Figure 1. First, the wood is cut from Oak forests located in the departments of Jutiapa and Santa Rosa. Next, the wood is loaded into 3 trucks at full capacity, 9 tons each, and it is transported to the company in Oratorio, where the wood is unloaded next to the ovens. Then, the wood is distributed into 11 ovens and placed inside them. For every 3 tons of wood, 1 ton of charcoal is made. The maximum capacity of the design is 11 tons, which is distributed in 1 ton maximum per oven. The effective capacity of the ovens is 10 tons. The efficiency of production is 90.9%. From every ton, 5kg is lost and considered production decline as a result of different factors such as moving the charcoal and filling sacks, among others. Later, a four-day process, called pyrolysis, occurs inside the ovens. For it to occur, the ovens must be turned on with fire and open, allowing oxygen to pass and help keep the fire alive for 1.5 days. Later, the ovens must be closed to stop the flow of oxygen and, therefore, extinguish the fire at a slow pace. By the fourth day, the wood has already changed into charcoal. At this moment, the charcoal is extracted from the ovens and left spread open over platforms to cool down. When the charcoal is no longer hot, sacks of 100 pounds are filled and later stored in the warehouse awaiting another truck to come and deliver them to the retail market "La Terminal". On average, 9.09 tons of wood charcoal are sent to the retail market.

Determining the Optimal Size of the Farm

The farm has 11 ovens for the production of charcoal. Each oven has a capacity of 0.82 tons of charcoal per week per oven, thus obtaining a total of 9.09 tons of charcoal per week (min 6.75 tons/week and max 10 tons/week). This gives a total production of 472.68 tons per year. The farm has a 10 X 20 warehouse with the capacity to store the weekly production, leaving a small remainder.

The farm has 4 operators in charge of production. There will not be an additional investment amount for the export of the product since the company will keep using the same infrastructure and quantity of ovens. On the other hand, extra expenses will appear, being \$94,400.00. The farm estimates a profitability of , with operating costs equivalent to X dollars.

Figure 2*Human Organization*

The human organization of the company consists of 5 people, the Manager, Jorge Molina, is in charge of supervising the quality of the charcoal, paying salaries, and developing administrative duties. Also, 4 operators labor all the activities required to produce wood charcoal. These operators live within the company's perimeter since their jobs are mostly developed at night and before sunrise. The company has been meticulously designed and equipped with all the necessary facilities to meet the legal requirements both in its production and in its commercialization in the local market. Every aspect of the company, from the location selection to the implementation of sustainable agricultural practices, has been carefully planned to ensure compliance with established regulations. In addition, quality controls have been carried out at every stage of the process, from sowing to harvesting and packaging, thus ensuring that all products leaving the farm meet high standards both in terms of food safety and quality.

Table 2*SWOT Analysis*

STRENGTHS	WEAKNESSES	OPPORTUNITIES	THREATS
The company has permanent clients at a local level	The raw material used is non-renewable	Expansion to the export market	Competition, market prices
The production cost is relatively low, considering that there was already a terrain and raw materials for the production of the final product	The company pays to transport the product to the market	High charcoal consumption in the export market	Economic losses

STRENGTHS	WEAKNESSES	OPPORTUNITIES	THREATS
Due to the quality of the product, it has one of the best prices on the market, being \$662.82 for a ton, unlike the average price of \$508.00	No expertise in export.	Better export price	Trade regulations
The company has the expansion capacity to increase production	It does not have certifications requested by the foreign market	Exportable quality of the product	Exchange rates
Proximity to the local market (Guatemalan City)	The company does not have direct contact with foreign clients	Proximity to export ports	Difficulty in storage

Local Market Characteristics

Buenos Aires company has been selling wood charcoal, since 2021, to the retail market “La Terminal”, located in zone 8 of Guatemala City. The local price stands at \$ 662.82 per ton, being sold 9.09 tons weekly, which sums up a total income of \$ 6,025 per week. The wood used to create charcoal is made from Oak trees (*Quercus peduncularis*). Regarding quality standards, the retail market in Guatemala City has a few parameters to check. The main parameters checked are the humidity, and maturation point.

Humidity must be between 5% and 15% of the total weight. It is measured by weighing the wood charcoal before and after putting it inside an oven until it gets fully dry. Another parameter checked is the mature point. The desired mature point for the market is reflected in the solidity of the wood charcoal, if it is overmature, it becomes dusty and easily breakable, meanwhile if it is at its optimal maturation point, it does not break easily.

The wood charcoal from the Buenos Aires company covers all the required standards for local commercialization. As a result, the company has had stable retail clients since 2021. These clients are distributors to grocery stores and charcoal sellers in retail market stores. The main usages that the final clients of the consumption chain of wood charcoal give are sources of heat power for cooking in restaurants and homemade barbecues.

The geographic area of the charcoal production of the company is Buenos Aires Estate, Oratorio, Santa Rosa. It has access to electricity, water, and streets. The main forests where the wood

is taken as raw material for creating charcoal are located 1 hour away from the company, and the retail market “La Terminal” (final destination) is located 4 hours away from the company. These aspects make the location of the company very convenient.

The channels of commercialization of the product are on land, transported by trucks, from the company to the retail market. The main route is the “CA-1 Oriente”, which passes Oratorio directly to the capital city of Guatemala.

The tendency of the production, consumption, and commercialization of wood charcoal in Guatemala has a prediction of growth. “The charcoal market reached a value of 77.85 million tons in the year 2023. It is estimated that the market will grow at a compound annual growth rate of 4.5% between 2024 and 2032, to reach a value of 115, 70 million tons in 2032.” (Claight Corporation, 2023).

Export Market Characteristics

The US market has a range of prices, the minimum is \$716.00 per ton, the maximum is \$1,002.00 per ton, and the most common price paid is \$895.00 per ton. Carbonera Buenos Aires company has the intention to export the same amount that it commercializes locally, 9.09 tons per week. Since the wood charcoal market in the US pays in FOB (Indexbox, 2024), to reduce costs of freight transportation, it is recommended that the company exports every 4 weeks since the container that would be used is 40 ft (max of 40 tons). Strict quality requirements must be met when exporting charcoal to the US market to maintain competitiveness and regulatory compliance. To provide good heat and minimal smoke, the coal should have a high carbon content of 75–85% and a low moisture content of less than 8%. Maintaining an ash content of three to five percent will improve combustion and reduce waste. For optimal energy production, the proportion of solids should not be greater than 15-20% and the proportion of stabilized carbon should be greater than 75%. The high calorific value of 7000–7500 kcal/kg and the quick burning time—better than 10 minutes—are also significant indicators of the money's quality. For consistent burning, the charcoal needs to be uniformly sized between 20 and 80 mm and strong enough to withstand impact or pressure tests where more than 95% of the material remains intact. For the safety and purity of the product, it is imperative that no

impurities, such as stones, metals, or uncarbonized wood, be present. Ensuring proper packaging in robust, moisture-resistant bags, usually weighing between 15 and 20 kg, aids in preserving quality throughout transportation and storage. Adherence to global benchmarks such as ISO 17225-1:2014 concerning solid biofuels guarantees that the product fulfills the essential safety and quality prerequisites for the US market, (KanBkam, 2024). The niche of the market in the US market is similar to the Guatemalan market that the company has at the moment. The expansion to the export market consists of selling the product as a commodity to the retail market in the US, at the moment, there is no specific client. The prices mentioned before are only a result of an investigation of the retail market of wood charcoal in the US. The commercialization channel would be maritime, from the port of Santo Tomás de Castilla, Puerto Barrios, Izabal to the port of Everglades, Miami, US.

Market Study Towards Export

World charcoal consumption has increased by 3 to 4% per year in recent years. The main countries exporting charcoal to the United States are Mexico, China, and Argentina, which account for more than 60% of imports, (Marciaga, 2015).

The main countries exporting charcoal to the United States are Mexico, China, and Argentina, which account for more than 60% of imports. Currently, there has been an increase in the volume and global trade of charcoal, which has adverse consequences for both the environment and the security of charcoal supply. Although charcoal remains essential in the energy matrix of Latin American countries, the world's major producers, such as African nations, India, Japan, and China, are also participating in this dynamic, (TrendEconomy, 2023).

The forest industry has an annual sales value of \$230 billion and employs 1.6 million people in 46 states. Approximately 20% of the land area of the United States is made up of forests, which produce an average of 1.38 cubic meters of industrial timber per hectare each year. Most of these forests, 71%, are privately owned, while the remaining 29% are publicly owned. The ratio of logging to tree planting shows a positive trend towards sustainability. There are a total of 86,000 companies

engaged in the timber industry, of which 19,000 are primary producers or processors, 53,000 secondary producers, and 14,000 furniture manufacturers.

The main ports of entry for U.S. imports in 2005 were Nogales, AZ; New York, NY; Houston, TX; San Francisco, CA; and Los Angeles, CA. Mexico, China, and Argentina are the main countries supplying charcoal to the U.S., accounting for more than 60% of imports. In 2005, charcoal imports amounted to \$17,681,000. Care must be taken with the costs associated with charcoal exports, especially transportation, as most of the wood exports from South America are destined for the East Coast of the United States. It is recommended to pay attention to the packaging of charcoal to avoid damage during transportation, which could result in the refusal of buyers in the U.S. market.

According to Food and Agriculture Organization (2022), U.S. charcoal imports in 2024 have been 154.6k, showing steady growth. China, Vietnam, and India are the main suppliers of charcoal to the United States. In general, prices have remained stable despite variations in recent years due to supply and demand. The United States is the largest importer of charcoal, followed by India and Vietnam, where strategies such as quality improvement and cost optimization have been observed.

It is expected that charcoal imports into the United States will continue to increase in the coming years driving consumption trends. The United States is the largest importer of charcoal, followed by India and Vietnam, where strategies such as quality improvement and cost optimization have been observed. Charcoal imports into the United States are expected to continue to increase in the coming years, driving consumption trends.

According to data from the (The Observatory of Economic Complexity, 2022), Guatemala recorded exports for a total value of US\$143 million at the end of 2022, making it the 68th largest exporter in the world during that period. Within its diversified export panorama, charcoal stood out as the country's fourteenth most exported product, confirming the significant potential of this product, and supporting the decision to export from Carbonera Buenos Aires. Therefore, the most relevant destinations for Guatemalan charcoal exports are the United States, with a value of \$68.8 million, followed by Honduras with \$26.1 million, El Salvador with \$17.1 million, India with \$5.14

million and China with \$4.21 million. Among these destinations, the United States is an attractive market due to the significant volume of coal imported by this country. In addition, the geographic proximity between Guatemala and the United States, together with the export facilities from the port of Santo Tomás de Castilla in Izabal to Miami, consolidate the latter as a strategic and favorable destination for the export of the coal produced.

Financial Study

Actual costs of the company

At the moment, Carbonera Buenos Aires Company has the following costs:

Fixed Costs.

These are \$76,782.05 per year, distributed into:

General electricity \$153.85

Electricity used per week wood charcoal production \$166.67

Salaries \$68,000.00

Maintenance of the ovens \$8,461.54

Variable Costs.

These are \$153,133.33 per year, divided into:

Cut of wood as raw material \$32,000.00

Loading of wood to the truck \$6,000.00

Costs per wood charcoal truckload \$40,000.00

Cost of transportation to the company \$50,000.00

Unloading the wood to the ovens \$2,000

Electricity used to produce wood charcoal truckloads \$166.67

Loading of charcoal to the truck \$6,000.00

Transportation shipping \$300.00

Cost of transportation to the market \$16,667.67

Investments

The company has a few investments that were done when everything started in 2021, these are a total of \$23,717.95, distributed in the following:

Construction material for ovens \$16,923.08

Charcoal cellar \$3,846.15

Galley (workers house) \$2,564.10

Legal fees \$384.62

Incomes Selling Locally

The company has one of the best prices per ton in the wood charcoal market in Guatemala, the total income per year is \$313,301.76, the selling price per ton is \$662.82 and total tons per year 472.68 on average.

Extra Costs Of Expansion Into Export

If the company decides to expand into the export market, extra costs would be added. Table 3 shows the exact costs that the company will have to incur annually. The cost of transportation to the port is described as the payment that has to be made to the shipping company when transporting the wood charcoal from Carbonera Buenos Aires to the Port Everglades in Miami, US. Since the FOB incoterm was the best option decided for the company with a better price at the moment for the wood charcoal Market in the US, the company would have to pay for a container. The container that would be used is of 40 ft, with a capacity of 40 tons. The customs fee (origin) has to be paid to allow the charcoal to pass through customs. Finally, the tax on the export bill is paid over the final cost per export. In total, every year the company incurs an extra cost of \$87,939.34

Table 3

Extra annual costs when exporting

Cost of transportation to the port	\$ 12,350.00
Container fee (40ft)	\$ 43,342.00
Customs fee (origin)	\$ 6,500.00
Tax on export bill	\$ 13,457.34
TOTAL	\$ 75,649.34

Comparison Between Local And Export Market

To demonstrate which option could be better, a cash flow was made with both scenarios (local and export). The financial indicators of each are stated below:

Local Cash Flow:

NPV = \$441,421.83

IRR = 28%

PRI (years) = 3.93

ID = 2.74

Export Cash Flow:

NPV = \$775,062.54

IRR = 37%

PRI (years) = 2.93

ID = 3.48

In simple sight, exporting is a better option for the company since financial indicators of the export cash flow are better than the local cash flow. The Net Present Value (NPV) of the export cash flow is higher than the local cash flow with a difference of \$333,640.71. The Internal Rate of Return (IRR) is higher when exporting, with 37%, representing a difference of 9% between both. The Period of Return on Investment (PRI) represents the amount of years that the company will have to wait to return the initial investment. The export cash flow has a PRI of 2.93 years, while the local cash flow has a PRI of 3.93 years. This financial indicator (PRI) demonstrates that export is better because the investments will return 1.00 year earlier than selling locally. The ID for the local cash flow is 2.74, this means that, for every dollar spent, 2.74 dollars will come as profit. On the other hand, the ID of the export cash flow is 3.48. The ID of the export cash flow is better than the local one with a difference of 0.74. In conclusion, the financial indicators of the export cash flow demonstrate that it is a better option to export rather than keep selling locally.

Figure 3

Cash flow of local market versus export market

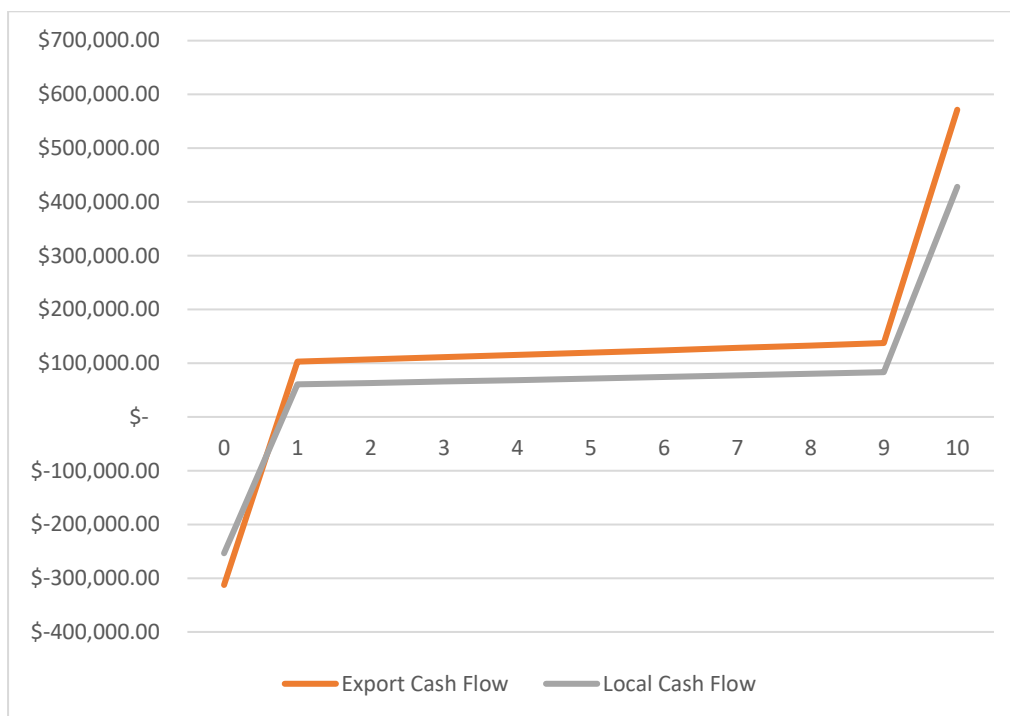


Figure 3 shows the projection for 10 years of the cash flow for export and local markets. The Y axis represents the incomes in thousands of dollars and the X axis the years that would pass. As a result, the export cash flow line is higher than the local cash flow line, proving graphically that it is a better option to export.

Risk Analysis

To estimate the probability of success, the software @risk was used. 50,000 possible scenarios were estimated using as reference 4 main variables. These are the selling price, weekly production of the company, annual inflation in Guatemala, and the cost of a wood truckload (raw material). The selling price ranges from a minimum of \$716.00 to a maximum of \$1,002.00, with an average price of \$895.00. Weekly production varies from 6.75 to 10 tons, averaging at 9.09 tons. Annual inflation is indicated with a minimum of 2.39%, an average of 4.03%, and a maximum of 6.88%. The cost per TL spans from \$384.62 to \$1,153.85, with an average cost of approximately \$769.23.

Figure 4 shows that there is a 1.8% probability that the NPV is less than zero when exporting, which would imply losses. On the other hand, there is a 98.2% probability that the NPV is greater than zero, indicating profits. This suggests a high probability that the project will generate benefits for the company. Probability of the NPV to be equal or higher to zero

Figure 4

Probability of the NPV to be equal or higher to zero

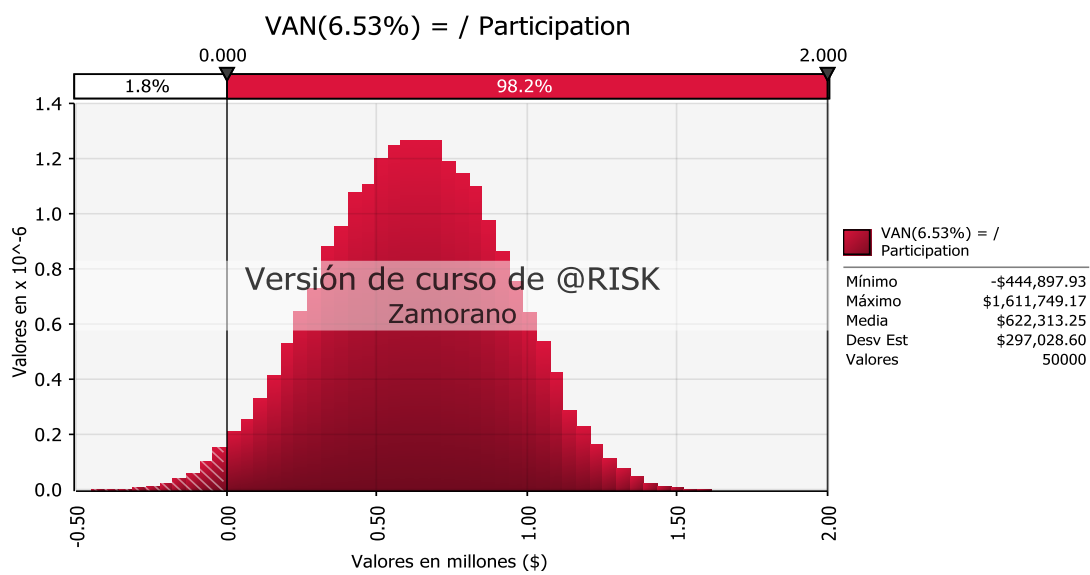


Figure 5 indicates a 31.6% probability that the NPV will be equal to or greater than expected when exporting, indicating profits. This shows that there is a high probability (68.4%) that the export will not generate the expected benefits for the company.

Figure 5

Probability of the export VAN to be equal to or higher than expected

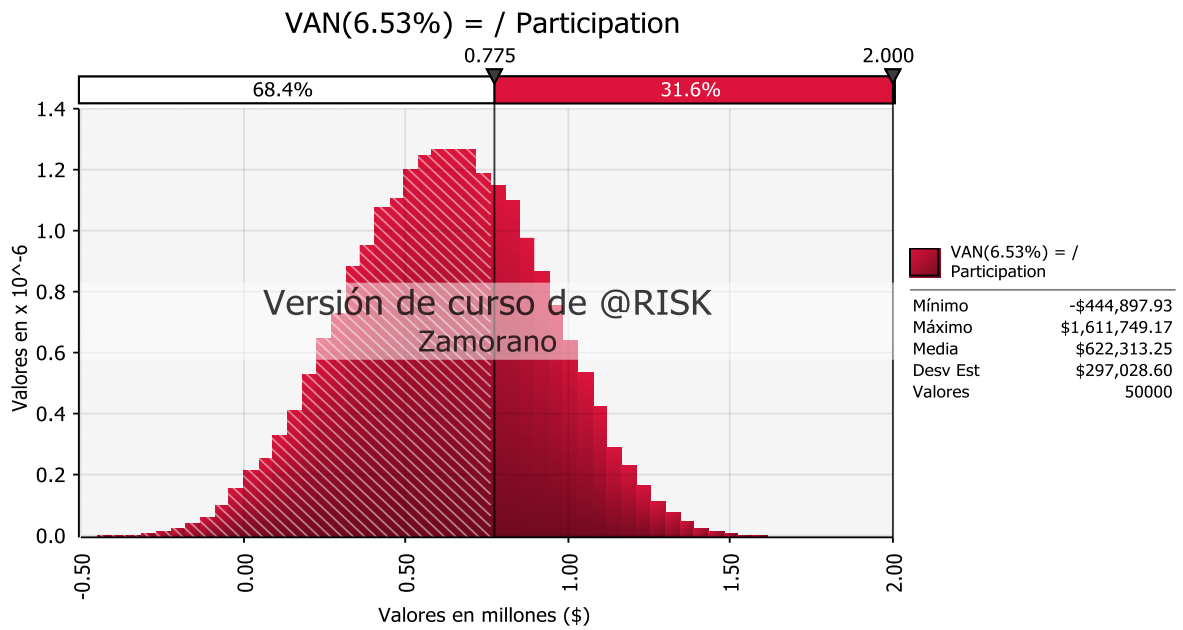


Figure 6 shows the probability that exporting will generate equal or higher NPV than the local NPV, demonstrating 72.2% positive results, and 27.8% that the export VAN will not be higher or equal.

Figure 6

Probability of obtaining an export VAN equal to or higher than the actual local VAN

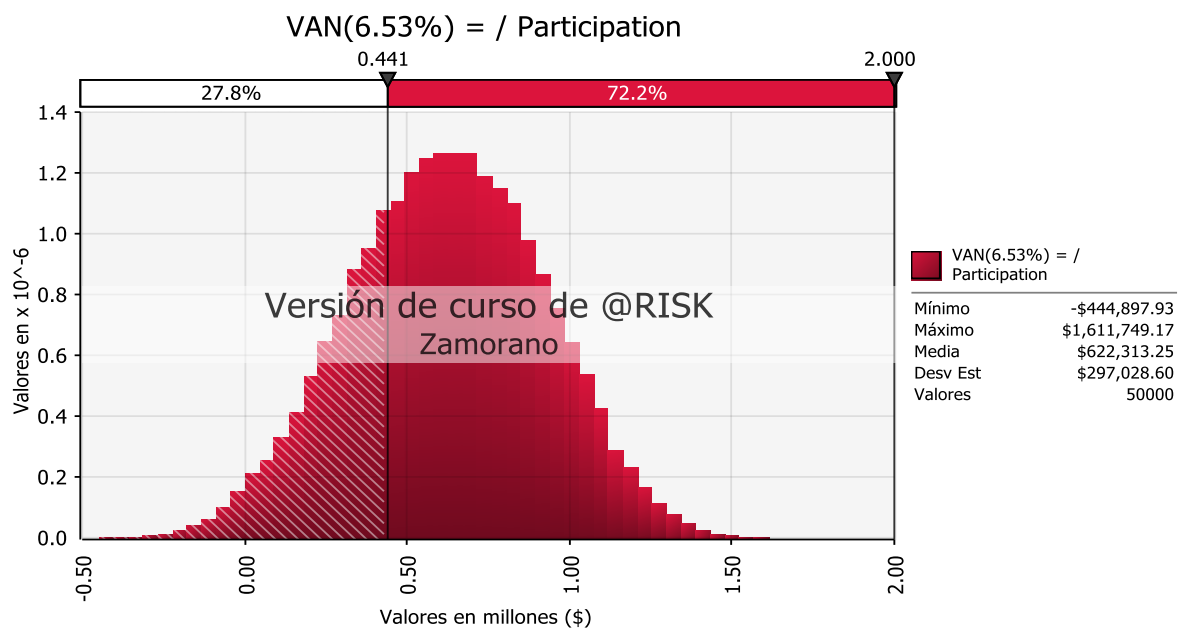


Figure 7 shows that the simulation results indicate a 6.5% probability that the IRR is less than the cost of equity capital and 98.2% greater. This suggests that the project has a high probability of generating profitability by selling the products by export.

Figure 7

Probability of obtaining an IRR higher than the cost of capital

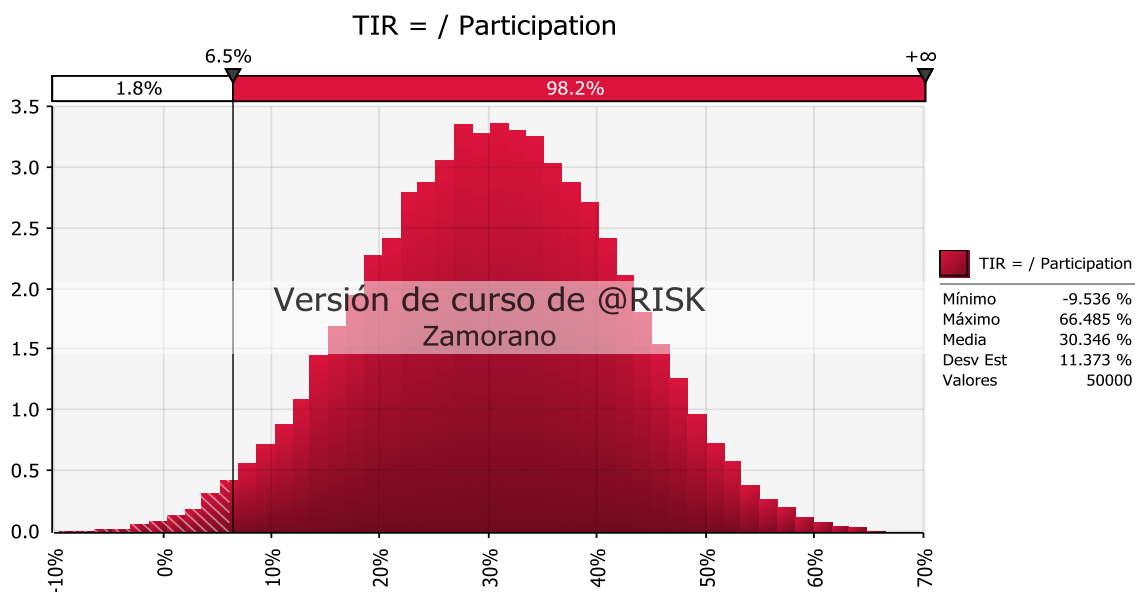


Figure 8 shows the probability distribution of the Internal Rate of Return when exporting, the indicator is located at 37%. The simulation results indicate that there is a 71% probability that the IRR is less than the cost of equity capital and a 29% probability that it is greater. This suggests that the project has a moderate to low probability of generating more profitability by exporting the products than expected.

Figure 8

Probability of the TIR to be equal to or higher than expected when export

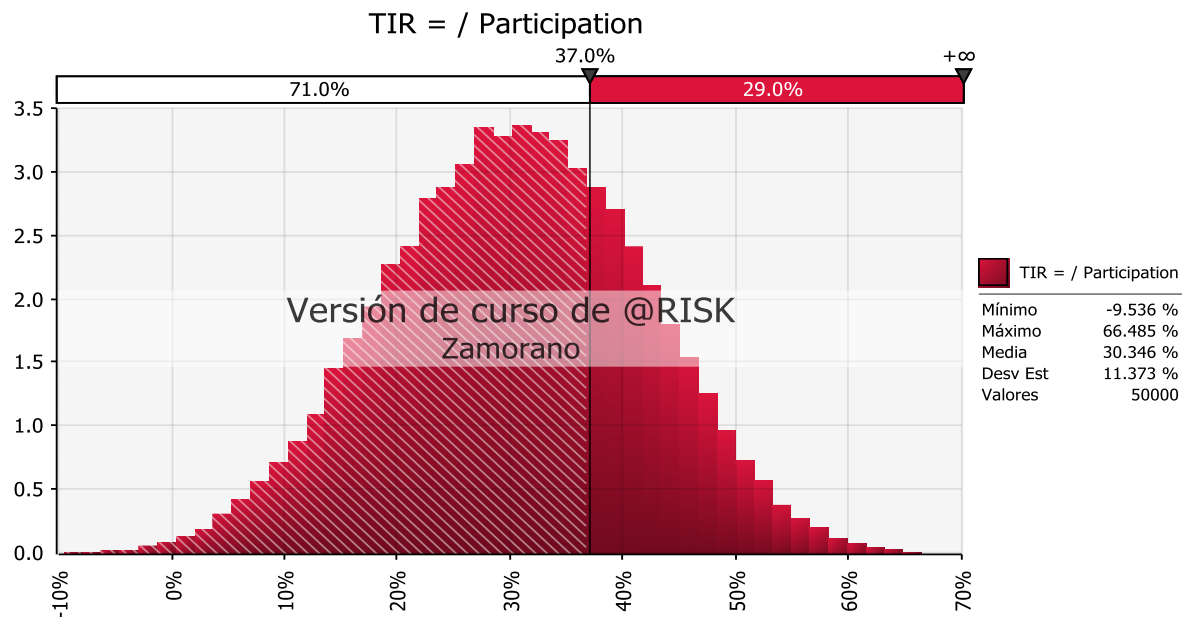
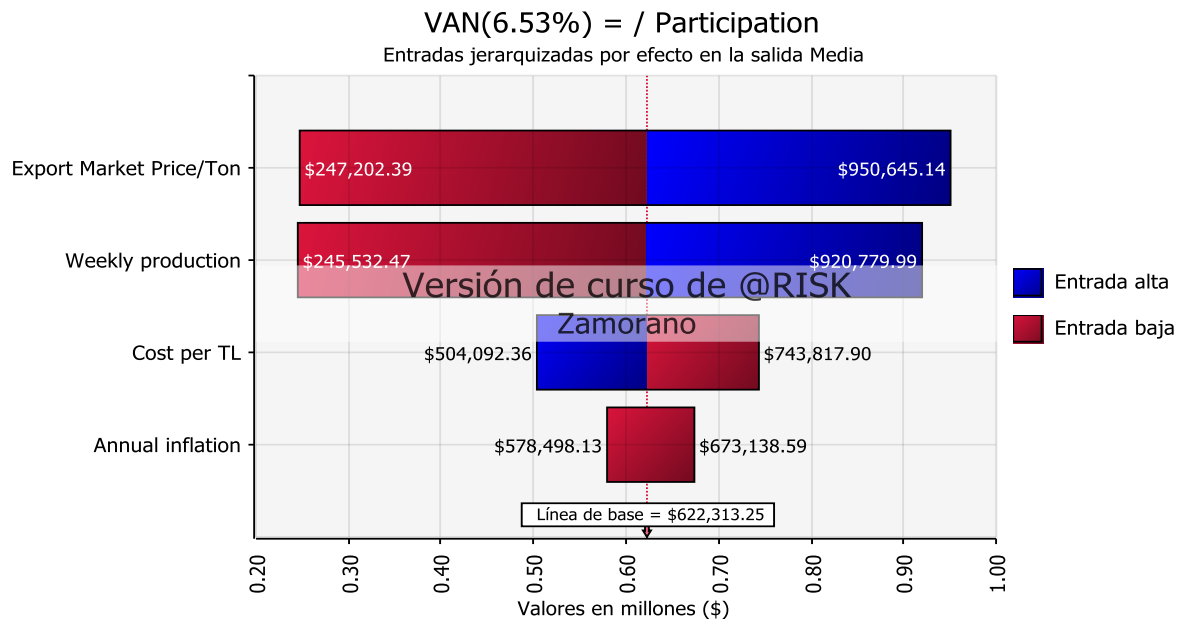


Figure 9 shows each entry variable and the impact they have on the exit variables. Based on the simulation of @risk, the variable that mainly affected the Net Present Value (NPV) and the Internal Rate of Return (IRR) was the export market price per ton because they depend directly on it since it is the main variable to consider when deciding to export or not. The second variable with the most impact was the weekly production because it affects directly the amount of wood charcoal produced and, therefore, the amount sold. The third variable with more impact is the cost per wood truckload since it is the cost of the raw material used to make wood charcoal. And last, is the annual inflation, affecting in little amount the financial indicators.

Figure 9

Stochastic variables that could affect risk when export



Conclusions

Among the different countries that import wood charcoal, the best option for Carbonera Buenos Aires Company to export is The United States of America since is the country with the best price per ton, \$895.00. Also, the incoterm used would be Free On Board since it is used for the US retail market.

The current financial structure of the company has good results but expanding to the export market would improve every financial indicator. The VAN will increase to \$775,062.54, the IRR to 37%, the PRI to 2.93 years, and the ID to 3.48, proving the positive increase in profitability. It is economically viable since the company has already the resources needed to start exporting.

The strategic plan used would be the same flow process the company already has, varying only in the final client of the charcoal, instead of selling to the retail market in Guatemala City, it would be the retail market of Miami, US.

Using the software @risk, 50,000 possible scenarios where estimated were the variables used in consideration were the selling price of export, weekly production of the company, annual inflation, and the cost per truck load used as raw material to produce wood charcoal. The software proved that there is a 72.2% probability of obtaining a higher profit than the actual one.

Recommendations

Establish formal clients with a higher price per ton in the export market to have economic security and guarantee income for the company.

Expand the brand of Carbonera Buenos Aires Company by adding extra value to the wood charcoal by packaging and selling it as a differentiated product in the local and international market, choosing the best option.

Increase production to keep selling locally and exporting since the company has enough space and resources required to double and even triple the actual production.

References

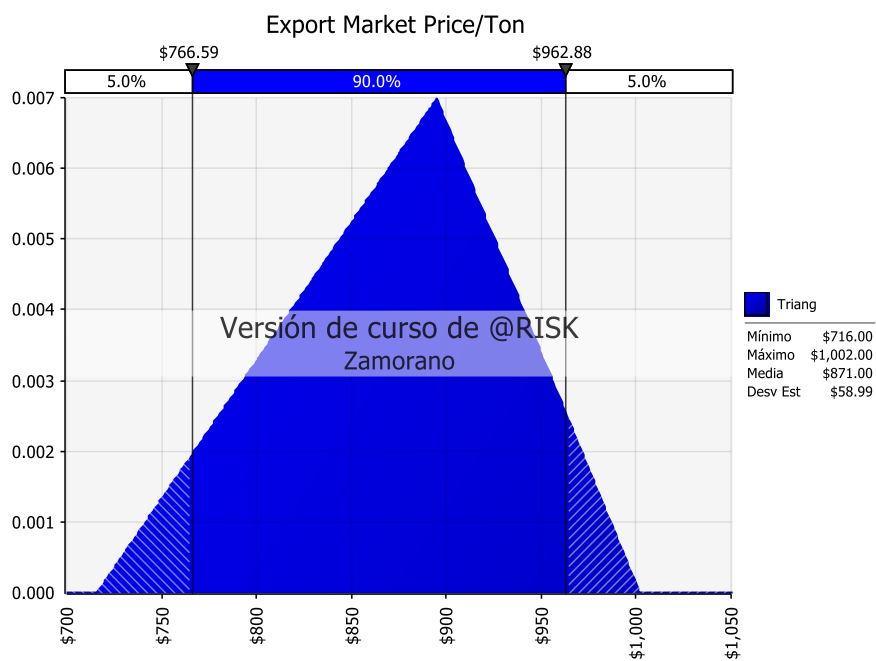
- Abascal, F. (2011). *Estudio de factibilidad para la producción de carbón vegetal Corral Viejo en Honduras* [Administración de Agronegocios, Escuela Agrícola Panamericana Zamorano]. bdigital.zamorano.edu. <https://bdigital.zamorano.edu/items/8c647c2a-fe6b-41f6-b739-1d89a91d55f6>
- Barbarán, M. (2019). *Caracterización de la Producción y Comercialización de Carbón Vegetal en el Distrito de Manatay, Coronel Portillo*. http://repositorio.unu.edu.pe/bitstream/handle/UNU/4254/000004140T_FORESTAL.pdf?sequence=1&isAllowed=y
- Claight Corporation. (2023). *Mercado Global de Carbón Vegetal – Por Uso Final (Doméstico, Industria Metalúrgica, Otros); Por Región (América del Norte, Europa, Asia Pacífico, América Latina y Medio Oriente y África); Dinámica del Mercado (2024-2032) y Panorama Competitivo*. <https://www.informesdeexpertos.com/informes/mercado-de-carbon-vegetal>
- Extínguelo. (2023). *Pirólisis: Transformando Biomasa y Plásticos en Recursos Valiosos*. <https://www.extinguelo.com/que-es-la-pirolisis-diferencia-combustion/>
- Food and Agriculture Organization. (2022). *Uso Eficiente del Carbón Vegetal*. <https://www.fao.org/4/X5328S/X5328S11.htm>
- Indexbox. (12/31/2023). *Japan: Wood Charcoal Market 2024*. <https://www.indexbox.io/store/japan-wood-charcoal-market-analysis-forecast-size-trends-and-insights-1/>
- Indexbox (12/27/2022). *Wood Charcoal Prices in China*. <https://www.indexbox.io/search/wood-charcoal-price-china/>
- KanBkam, I. (2024). *Charcoal bag 10 Kg. Super market KanBkam*. <https://supermarket.kanbkam.com/sa/en/charcoal-bag-10-kg-C641037>
- Marciaga, R. (2015). *Estudio de mercado para carbón vegetal en Tegucigalpa, Honduras* [, Escuela Agrícola Panamericana, Zamorano]. bdigital.zamorano.edu. <https://bdigital.zamorano.edu/items/428a6779-2dfd-496e-b0fa-c866d5189baa>
- The Observatory of Economic Complexity. (2022). *Madera, carbón vegetal y manufacturas de madera; Corcho y manufacturas de corcho; Manufacturas de espartería o de cestería en Guatemala*. <https://oec.world/es/profile/bilateral-product/wood-products/reporter/gtm>
- Padilla, C. (2013). *Estudio de factibilidad para la producción de carbon vegetal en Zamorano y su comercialización en Tegucigalpa, Honduras* [, Zamorano: Escuela Agrícola Panamericana]. bdigital.zamorano.edu. <https://bdigital.zamorano.edu/items/5d8cb1dd-5104-4770-a466-a32a2877614e>
- Statista. (2023). *Carbón: mayores consumidores a nivel mundial en 2022*. <https://es.statista.com/estadisticas/635491/paises-lideres-en-el-consumo-de-carbon/>
- TrendEconomy. (2023). *Annual International Trade Statistics by Country (HS)*. <https://trendeconomy.com/data/h2/UnitedStatesOfAmerica/4402>

Appendices**Appendices A***Variables used as entry in @risk*

Variable	Min	Average	Max	Distribution
Selling price	716.00	895.00	1,002.00	Triang
Weekly production	6.75	9.09	10	PERT
Annual inflation	0.0239	0.0403	0.0688	Traing
Cost per TL	384.62	769.231	1153.85	Triang

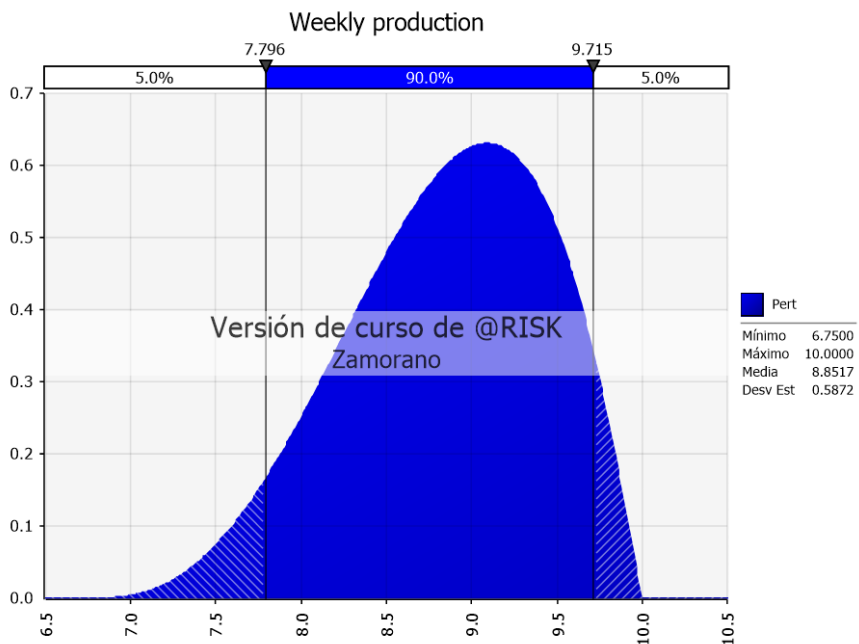
Appendices B

Distribution of the entry variable export market price/ton



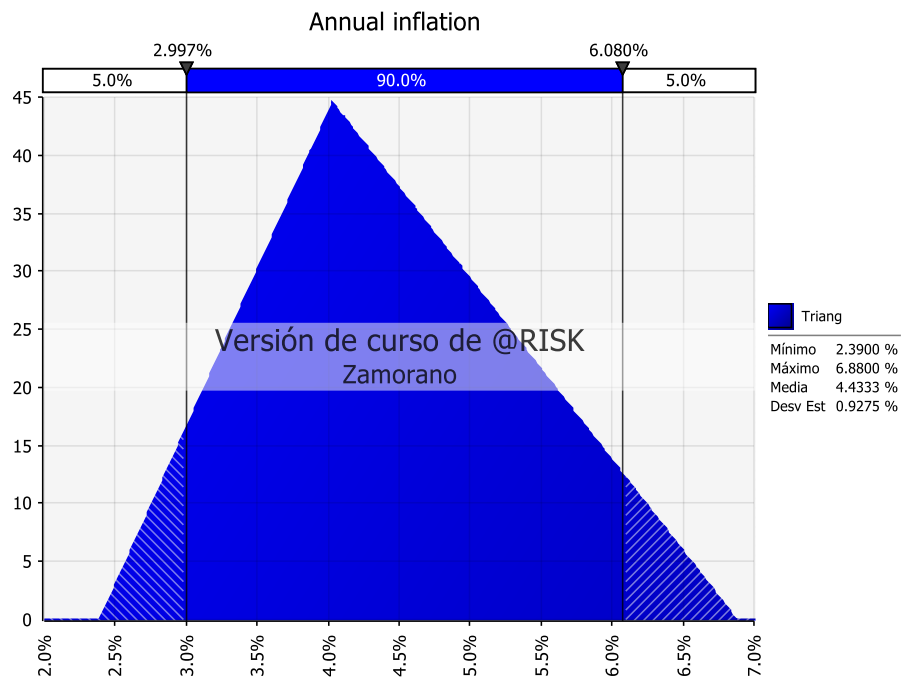
Appendices C

Distribution of the entry variable weekly production



Appendices D

Distribution of the entry variable annual inflation



Appendices E

Distribution of the entry variable cost per truckload

