UNIVERSIDAD DE INVESTIGACIÓN DE TECNOLOGÍA EXPERIMENTAL YACHAY

Escuela de Ciencias Químicas e Ingeniería

TÍTULO: Application of the Canvas Methodology in the Design of a Business Model for an Industrial Vacuum Freeze-Drying Plant

Trabajo de integración curricular presentado como requisito para la obtención del título de Petroquímico

Autor:

Bryan Renan Inlago De La Cruz

Tutor:

Claudio Arcos, Ph. D.

Urcuquí, Julio 2021

Urcuquí, 15 de junio de 2021

SECRETARÍA GENERAL
(Vicerrectorado Académico/Cancillería)
ESCUELA DE CIENCIAS QUÍMICAS E INGENIERÍA
CARRERA DE PETROQUÍMICA
ACTA DE DEFENSA No. UITEY-CHE-2021-00006-AD

A los 15 días del mes de junio de 2021, a las 14:00 horas, de manera virtual mediante videoconferencia, y ante el Tribunal Calificador, integrado por los docentes:

Presidente Tribunal de Defensa	Dr. RICAURTE FERNANDEZ, MARVIN JOSE , Ph.D.
Miembro No Tutor	DOCTOR JIMA GONZALEZ, ALEXANDRA DEL CARMEN
Tutor	Dr. ARCOS PROAÑO, CLAUDIO MARCELO , Ph.D.

El(la) señor(ita) estudiante **INLAGO DE LA CRUZ, BRYAN RENAN**, con cédula de identidad No. **1725311607**, de la **ESCUELA DE CIENCIAS QUÍMICAS E INGENIERÍA**, de la Carrera de **PETROQUÍMICA**, aprobada por el Consejo de Educación Superior (CES), mediante Resolución **RPC-SO-39-No.456-2014**, realiza a través de videoconferencia, la sustentación de su trabajo de titulación denominado: **APPLICATION OF THE CANVAS METHODOLOGY IN THE DESIGN OF A BUSINESS MODEL FOR AN INDUSTRIAL VACUUM FREEZE-DRYING PLANT**, previa a la obtención del título de **PETROQUÍMICO/A**.

El citado trabajo de titulación, fue debidamente aprobado por el(los) docente(s):

Tutor	Dr. ARCOS PROAÑO, CLAUDIO MARCELO , Ph.D.

Y recibió las observaciones de los otros miembros del Tribunal Calificador, las mismas que han sido incorporadas por el(la) estudiante.

Previamente cumplidos los requisitos legales y reglamentarios, el trabajo de titulación fue sustentado por el(la) estudiante y examinado por los miembros del Tribunal Calificador. Escuchada la sustentación del trabajo de titulación a través de videoconferencia, que integró la exposición de el(la) estudiante sobre el contenido de la misma y las preguntas formuladas por los miembros del Tribunal, se califica la sustentación del trabajo de titulación con las siguientes calificaciones:

Tipo	Docente	Calificación
Miembro Tribunal De Defensa	DOCTOR JIMA GONZALEZ, ALEXANDRA DEL CARMEN	9,5
Tutor	Dr. ARCOS PROAÑO, CLAUDIO MARCELO , Ph.D.	10,0
Presidente Tribunal De Defensa	Dr. RICAURTE FERNANDEZ, MARVIN JOSE , Ph.D.	10,0

Lo que da un promedio de: **9.8 (Nueve punto Ocho)**, sobre 10 (diez), equivalente a: **APROBADO**

Para constancia de lo actuado, firman los miembros del Tribunal Calificador, el/la estudiante y el/la secretario ad-hoc.

Certifico que *en cumplimiento del Decreto Ejecutivo 1017 de 16 de marzo de 2020, la defensa de trabajo de titulación (o examen de grado modalidad teórico práctica) se realizó vía virtual, por lo que las firmas de los miembros del Tribunal de Defensa de Grado, constan en forma digital.*

INLAGO DE LA CRUZ, BRYAN RENAN
Estudiante

MARVIN JOSE RICAURTE FERNANDEZ
Firmado digitalmente por MARVIN JOSE RICAURTE FERNANDEZ
Fecha: 2021.07.08 14:58:23 -05'00'

Dr. RICAURTE FERNANDEZ, MARVIN JOSE , Ph.D.
Presidente Tribunal de Defensa

CLAUDIO MARCELO ARCOS PROANO

Firmado digitalmente por CLAUDIO MARCELO ARCOS PROANO
Fecha: 2021.07.08 13:06:04 -05'00'

Dr. ARCOS PROAÑO, CLAUDIO MARCELO , Ph.D.
Tutor

Firmado electrónicamente por:
ALEXANDRA DEL CARMEN JIMA GONZALEZ

R JIMA GONZALEZ, ALEXANDRA DEL CARMEN
Miembro No Tutor

CARLA SOFIA YASELGA NARANJO

Digitally signed by CARLA SOFIA YASELGA NARANJO
Date: 2021.06.24 15:17:44 -05'00'

YASELGA NARANJO, CARLA
Secretario Ad-hoc

AUTORIA

Yo, **BRYAN RENAN INLAGO DE LA CRUZ**, con cédula de identidad 1725311607 declaro que las ideas, juicios, valoraciones, interpretaciones, consultas bibliográficas, definiciones y conceptualizaciones expuestas en el presente trabajo; así cómo, los procedimientos y herramientas utilizadas en la investigación, son de absoluta responsabilidad de el/la autora (a) del trabajo de integración curricular. Así mismo, me acojo a los reglamentos internos de la Universidad de Investigación de Tecnología Experimental Yachay.

Urcuquí, Julio 2021.

Bryan Renan Inlago De La Cruz

CI: 1725311607

AUTORIZACIÓN DE PUBLICACIÓN

Yo, BRYAN RENAN INLAGO DE LA CRUZ, con cédula de identidad 1725311607, cedo a la Universidad de Tecnología Experimental Yachay, los derechos de publicación de la presente obra, sin que deba haber un reconocimiento económico por este concepto. Declaro además que el texto del presente trabajo de titulación no podrá ser cedido a ninguna empresa editorial para su publicación u otros fines, sin contar previamente con la autorización escrita de la Universidad.

Asimismo, autorizo a la Universidad que realice la digitalización y publicación de este trabajo de integración curricular en el repositorio virtual, de conformidad a lo dispuesto en el Art. 144 de la Ley Orgánica de Educación Superior.

Urcuquí, Julio 2021.

Bryan Renan Inlago De La Cruz

CI: 1725311607

ACKNOWLEDGMENT

I would like to express my fraternal thanks to my mother, father, and sisters. It would have been challenging to continue my third-level studies, and this thesis would not have been possible without their support. I really, eternal gratitude for all the good that they have given me throughout my life.

Also, I would like to offer a special thanks to my tutor Claudio Arcos, who has been an essential pillar in the development of my work. Initially, for being the one who welcomed me as his student without even knowing anything about me. Then, for all your availability to help me. His patience and understanding throughout this process.

Besides, I would like to thank my friend Fernando Gushque, my teacher Marvin Ricaurte, Gerardo Alvarado and Fernando Caicedo. They supported me with their knowledge and suggestions during the preparation of this work.

Also, I want to express a special thanks to the Yachay Tech family. They have all directly or indirectly influenced me during my six years at the university. Those years where I grew up as a professional and as a human being.

Besides, I would like to thank the economist Rafael Correa, who was the one who made the construction of Yachay Tech possible, and mainly for the education reforms that took place in his government. Reforms that allowed me to continue and finish my third level studies.

Finally, a huge thank you to my friend José Ángel Rivera, who has given me his unconditional support from the first moment both on an academic and personal level. Your help has influenced all the significant changes I have had on a professional level; this project was our idea.

DEDICATION

I want to dedicate this thesis to my whole family: my parents, sisters, grandparents, uncles, cousins, to all of them who trust me, who see me as the first person in the family who is going to complete their third level studies. I dedicate this work to them because they have been the inspiration for the construction of this project and because, together with them, we will make it come to a reality.

RESUMEN

El Plan Nacional del Buen Vivir promueve el desarrollo de la industria no petrolera alineándose al cambio de la matriz productiva del Ecuador como eje fundamental para el desarrollo industrial de la nación. En este trabajo se presenta una propuesta de negocio para la implementación de una industria de liofilización de alimentos para las provincias de Imbabura y Pichincha usando la Metodología Canvas. Inicialmente, se realizó un estudio de mercado para la obtención de información que sustente esta metodología. Se determinó la necesidad de dar un valor agregado a las 300 ton/mes de fresa que se producen en las zonas de Cayambe, Otavalo y Pedro Moncayo y se identificó la aceptación que tendría un producto liofilizado por parte de las personas en la ciudad de Quito. Con estos resultados, se plantean dos propuestas de valor, los productos liofilizados y el alquiler de servicios de clasificación de frutas, para el segmento de mercado. Luego, se procedió a identificar y diseñar los procesos unitarios fundamentales de la planta de liofilización. Finalmente, se realizó una evaluación básica de la viabilidad del proyecto mediante el uso de indicadores económicos de flujo de caja dinámico y se obtiene un valor actual neto (VAN) de 229,631 USD, una tasa interna de retorno (TIR) de 27.92 %. Finalmente, se estimó que el tiempo de recuperación de la inversión es de tres años y diez meses, comprobando la viabilidad del proyecto.

Palabras claves: metodología canvas, planta de liofilización, valor actual neto, tasa interna de retorno, periodo de recuperación.

ABSTRACT

"Plan Nacional del Buen Vivir" promotes the development of the non-oil industry by aligning itself with the change in the productive matrix of Ecuador as a fundamental axis for the industrial development of the nation. Thus, in this work, a business proposal is designed to implement a food lyophilization industry for the provinces of Imbabura and Pichincha using the Canvas methodology. Initially, a market study is carried out to obtain information that supports this methodology. The need to give added value to the 300 tons/month of strawberries produced in Cayambe, Otavalo, and Pedro Moncayo cantons was determined, and the acceptance that a lyophilized product would have on the part of the people in Quito city. These results help to propose two value proposals, lyophilized products and the rental of fruit sorting services, the market segment. Then, the fundamental unit processes of the lyophilization plant are identified and designed. Finally, a basic evaluation of the project viability is carried out using economic indicators of dynamic cash flow, and a net present value (NPV) of 229,631 USD is obtained, an internal rate of return (IRR) of 27.92 %. The investment recovery time was estimated to be three years and ten months, verifying the project viability.

Keywords: canvas methodology, vacuum freeze-drying plant, net present value, internal rate of return, recovery period.

TABLE OF CONTENT

List of Figures

List of Tables

List of Diagrams

List of Equations

CHAPTER I

1. DIAGNOSIS AND PROJECT OBJECTIVE

1.1. Problem Approach

In Ecuador, 60 % of the population is engaged in agriculture (Cassinelli, Moretta, & Peñaherrera, 2010). As a result of this, the central objective is of the state is to give added value to these products to change the country's productive matrix, allowing for the generation of new business models. In areas between the provinces of Pichincha and Imbabura, strawberry production reaches up to 500 tons per month (Gobierno Autonomo Descentralizado de Gonzales Suarez, 2015). However, most farmers rely on the price of strawberries based on the sale of fresh fruit, which is currently their only market source and the only form of business they manage.

According to the farmers of these locations, the sale of fresh strawberries can vary significantly, between 2.00 USD to 20.00 USD for the following reasons: 1) the specificity of the growing season for the strawberries, 2) the varied quality of the fruit, and 3) because of the quick rate at which the fruit decomposes. Of these three reasons, the rapid decomposition of fewer than two weeks results in significant losses in production and earnings (Instituto de Desarollo Agropecuario, 2017). Products not sent to market before perishing are considered food waste, a situation made worsened by the COVID-19 pandemic, which has caused a drastic fall in the economy. The activation of the economy during and post-COVID-19 will depend on the increasing capacity of association, improving the evolution of production systems, and creating new business models.

Based on the problems mentioned at last paragraph, a study is carried out to determine the economic viability of a new business model that takes advantage of the strawberry production from Cayambe, Otavalo and Pedro Moncayo areas.

1.2. Justification

In Ecuador, one of the main objectives of the "Plan Nacional del Buen Vivir" is to change the country's productive matrix through the transformation and diversification of national production (National Planning Council, 2017). To achieve this long-term objective, the current government, in the master plan "Plan Nacional del Buen Vivir 2017-2021, Toda una vida," establishes policies to promote the change of the productive matrix, linking the public sector, industries, and universities.

In this framework, the provinces of Imbabura and Pichincha present a high production of raw material (strawberry), which has a high potential to give added value with the industrialization of this product. In turn, a study carried out in Latin America shows the growing demand for healthy foods; in Ecuador, it is 32% (Nielsen, 2016). In addition, the Modor Intelligence and Market Insights (2020) pollster determines that the commercialization for freeze-dried foods will grow by 8% annually due to their high nutritional properties. With this, a business opportunity is evident in the healthy food industries.

However, it is necessary to design a business model appropriate to the circumstances of these areas to will have success. So the Canvas methodology is considered the best to carry out the success of a new company. It is a simple tool that covers both the external and internal fields of a business, allowing large, medium, and small companies to apply it (ESAN, 2016). Some of the companies that use it are IBM, Ericsson, Deloitte, among others.

Finally, every company considers it necessary to reduce the uncertainty of the viability of a new project. Therefore, they realize an essential economic and financial study to analyze the cash flows in the project horizon. Usually, the economic indicators for these analyzes are net present value (NPV), internal rate of return (IRR), and benefit-cost ratio (B / C).

1.3. Research Questions

- What are the advantages of using the Canvas business model for the generation of a new micro-business?
- What market opportunities exist in Quito city to vacuum freeze dryer products?
- What benefits will strawberry farmers from Cayambe, Otavalo and Pedro Moncayo cantons obtain by applying a new business model about a vacuum freeze-dried plant?

1.4. Objectives

1.4.1. General Objective

To apply the Canvas model in designing a business model for an industrial plant to produce freeze-dried vacuum food for the segments market in Quito city.

1.4.2. Specific Objectives

- To identify the fundamental stages of the lyophilization process using bibliographic sources.
- To design the process of an industrial plant for the freeze-drying of food with a processing capacity of 100 kg/day.
- To create a new business model for a vacuum freeze-drying plant using Canvas Methodology.

- To perform a financial profitability analysis for the vacuum freeze-drying process using dynamic discounted cash flow methods.

1.5. Methodology

The present study uses a non-experimental methodology consisting of three approaches: quantitative, qualitative, and deductive.

In the first stage, the deductive approach is used to establish the correct steps of liofilizatión and designing the process of the strawberry vacuum freeze-dried industrial plant. For this, it is necessary to consider bibliographic sources to identify the fundamental processes of lyophilization. Next, a quantitative approach is used to determine the values of mass flow during all steps. For this, we use Lomonosov-Lavoisier Law of Conservation of Matter, considering the steady-state throughout the process. Later, using the computer-aided design program (AUTO-CAD), it elaborated a general plant scheme and a block diagram.

Second, a qualitative approach is used to identify and describe the steps of Canvas. In this instance, it is necessary to make a database using bibliographic sources and surveys for diagnosing the marketing system of the strawberry. After, the business proposal for the industrial lyophilization plant is designed. Finally, considering certainty conditions and using an analytical approach, it is relevant to evaluate the project financially using dynamic discounted cash flow methods to establish economic and financial viability.

The study has six chapters to address all of these steps. Chapter 1 presents the problem, the applied methodology, the justification, and the objectives set. Then Chapter 2 details the fundamental concepts of the essential topics of this study. Topics are related to the freeze-drying process, canvas methodology, and economical methods of project evaluation. Consequently, Chapter 3 shows essential data on the reality of the country and the results of

market research. Next, Chapter 4 details the business proposal for the lyophilization plant based on the preliminary investigation of Chapter 3. Besides, Chapter 5 shows the economic evaluation results; Appendix A presents tables and graphs to complement and justify the results of this chapter. Finally, Chapter 6 presents the conclusions and recommendations of the study carried out.

CHAPTER II

2. BACKGROUND AND LITERATURE REVIEW

2.1. Fundamentals of Freeze Drying

Vacuum freeze-drying is a dehydration process that stabilizes the product, first freezing it to concentrate the solvent (water), and then reducing it by sublimation and desorption to low levels where they will not produce microbiological growth and chemical reactions (Jennings, 1999). When performing this process, we preserve the organoleptic properties of food, reduce its weight, stabilize its properties when rehydrated, and facilitate storage at room temperature for longer than traditional drying (Teagarden, Wei, & Baker, 2010).

The principle on which the lyophilization process is the sublimation, a physical phenomenon, consists of bringing water to the gaseous state from the solid-state (ice crystals) without going through the liquid state (Gaidhani, Harwalkar, Bhambere, & Nirgude, 2015). Sublimation of frozen water occurs below the triple point when steam pressure is less than 4.60 Torr and the temperature is less than 0.01 ° C (Atkins & Jones, 2007).

The food to be dehydrated is frozen and then subjected to a high vacuum in a special chamber. At a value lower than the maximum sublimation speed, a fluid pass through the food, giving it heat to accelerate dehydration (Atkins & Jones, 2007). The extraction of water molecules occurs from the surface to the core of the food in two stages. First, applying sublimation, approximately 15 % humidity is reached, after reducing the maximum moisture content of 2 % is achieved with the desorption of the non-freezable water. As a result of this, the aliment obtains a spongy, porous, and dry solid structure (Fellows, 2009).

2.1.1. Stages of Freeze-Drying

The process of freeze-drying a food is carried out in three stages (Figure 1). Initially, at a breakneck speed, the product freezes, forming tiny crystals of water with an amorphous structure. The temperature is increased, preserving low vapor pressures below the triple point, which allows the dehydration of the food preserving all its nutritional and organoleptic properties (Figure 2).

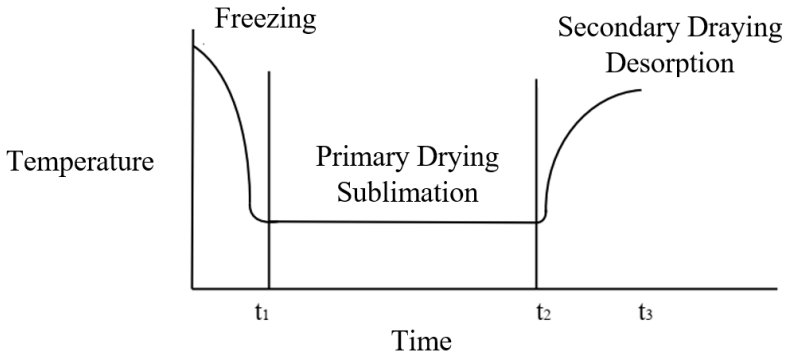


Figure 1: Stages of the food vacuum freeze drying process.
Source. (Barbosa & Vega, 2000).

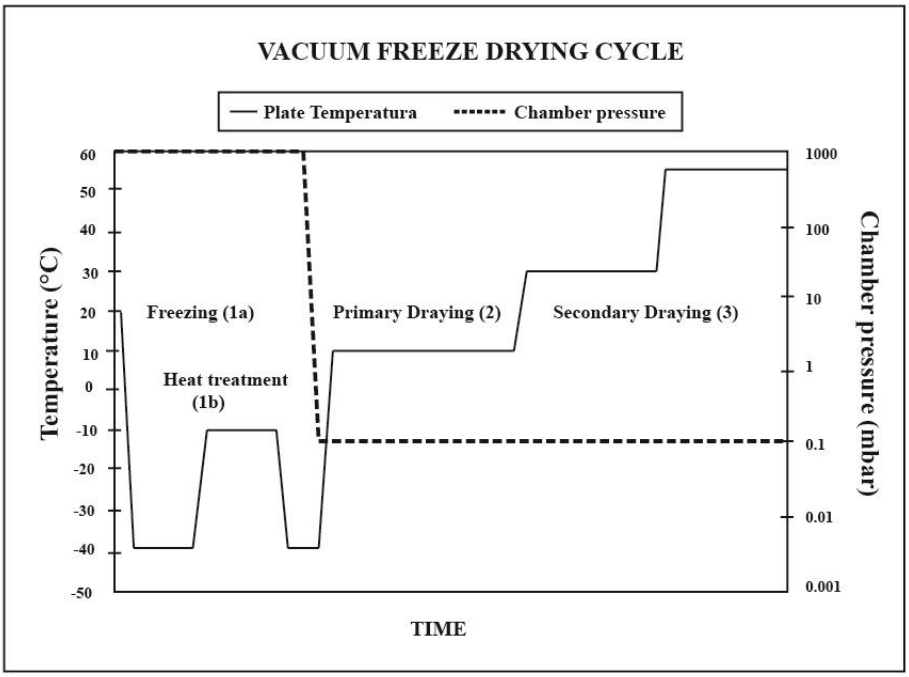


Figure 2. Thermal history of a freeze-drying process.
Source. (Roos, 1987).

Figure 3 shows the three phases of lyophilization. Initially, the product is frozen with a decrease in vapor pressure below the triple point, creating a vacuum in the chamber. After, two drying stages occur, where it is necessary to apply heat for forming a sublimation surface or interface of the frozen and dry phase of the food. The dry layer will increase as time passes; the longer the time, the lower the water content in the food.

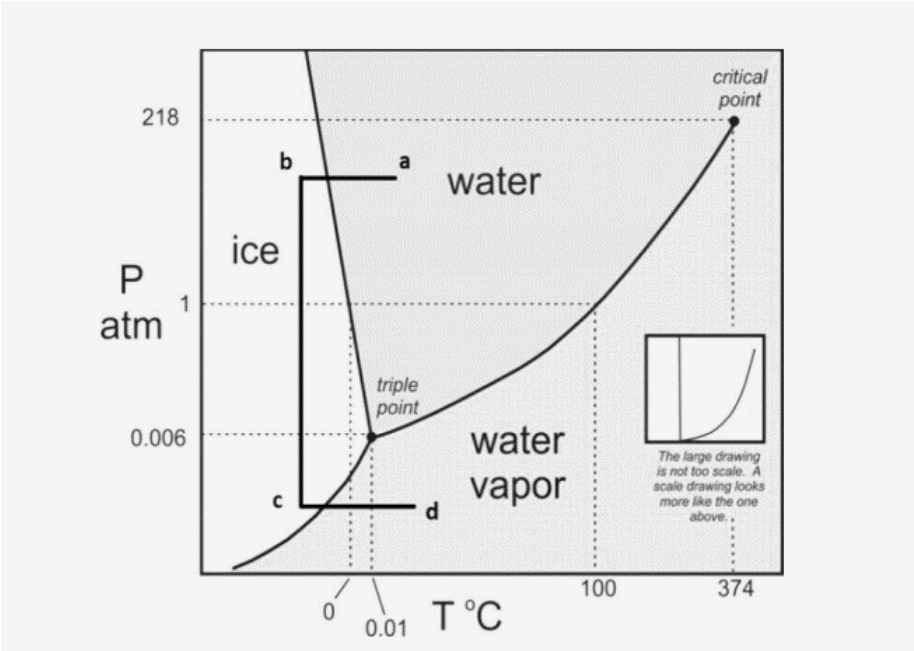


Figure 3. Phases of lyophilization.
Source. (Karelovic, 2012)**.**

In the lyophilization process, the heat flow from the chamber is transferred by conduction, convection, or radiation reaches the outer surface of the food. Figure 4 shows the transfer of heat by conduction to the sublimation surface. During this process, the temperature and humidity in the food vary according to the mass and heat transfer rates. Mass transfer occurs through the dry layer by a pressure differential, while the sublimation front transfers heat. Also, it is essential to keep temperatures and pressures below their maximum during freezing and drying to keep product degradation to a minimum (Geankoplis, 1999).

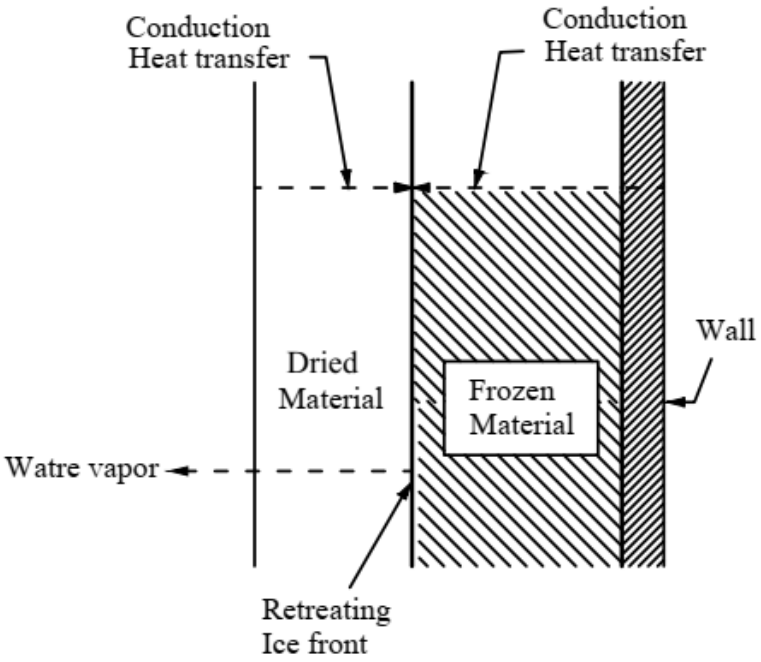


Figure 4. Heat and mass transfer in the freeze-drying process.
Source. (Geankoplis, 1999).

2.1.1.1. Freezing:

The food freezing stage is one of the most important in the vacuum freeze-drying process; it determines the quality of the final product and the performance of the process. The food to be frozen is subjected to temperatures below 0 ° C where there is no movement of the contained water or solutes, volume contraction, and chemical activity (Benavente & Garcia, 1999). When the food is frozen, the contained water in them solidifies, forming crystalline structures. The cooling rate is directly proportional to the number of crystals and inversely proportional to their size. Besides, it is essential to mention that the larger the size of the crystals, the structural damage increases, mainly to the tissues, for the increase in pressure inside of food (Figure 5). Besides, the deterioration of cell membranes causes nutritional losses, alters the texture, and severely affects the organoleptic properties (Brennan & Grandison, 2011) (Otero, Martino,

Zaritzky, Solas, & Sanz, 2000). However, the sublimation speed is directly proportional to the size of the pores left by the water crystals; in other words, the larger the crystals, the greater the drying speed of the food inside the lyophilization chamber.

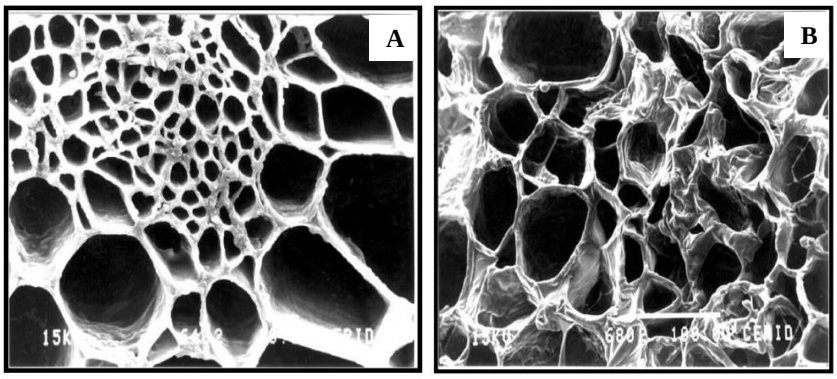


Figure 5. Structural differences with different cooling rates.
Source. (Karelovic, 2012).

Figure 6 shows an example of collapse during sublimation, causing structural damage, changes in color and aroma, decreased nutrients, slow sublimation speed, and increased food density (Ahmed & Rahman, 2012). This phenomenon occurs in food whit a frozen properly. For this reason, it is necessary to keep the temperature of the food below its collapse temperature during the freezing stage and not reach the maximum sublimation speed during the two drying periods.

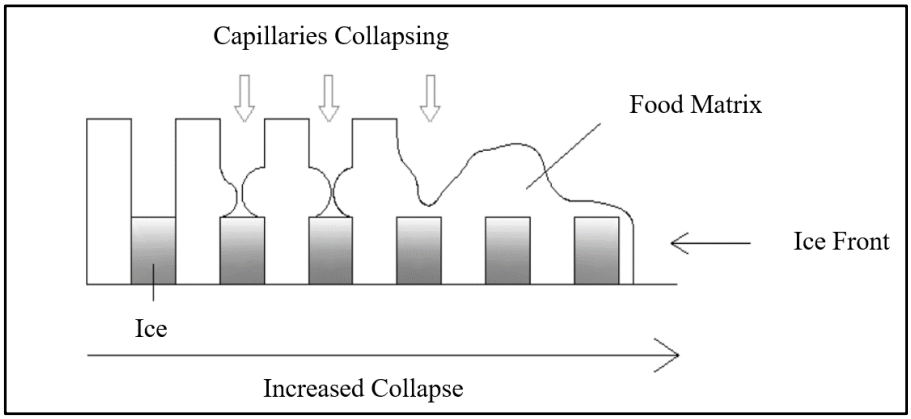


Figure 6. Progressive stages of collapse.
Source. (Barbosa & Vega, 2000).

2.1.1.2. Sublimation

Crystallized water particles, between 75 % and 90 % formed during freezing, evaporate (Franks, 1986). By applying energy through latent heat, the solid water phase sublimates from the surface to the inside of the food. The water vapor formed is eliminated through the pores due to the low pressure in the lyophilization chamber. Figure 7 shows the sublimation proceeds in two phases. In the first phase, also called the conductive stage, the plates are heated, and the sublimation speed increases until reaching a maximum. This stage is the shortest, occupying between 10 % and 15 % of the total drying time. In phase 2, the first diffusion stage occurs where there is a decrease in the sublimation speed due to resistance to heat and steam in the dry-porous layer (White & Cakebread, 1966). The driving force of these two phases is the pressure differential that originates between the water pressure gradient at the ice interface and the partial pressure of the water vapor in the vacuum freeze-drying chamber (Barbosa & Vega, 2000).

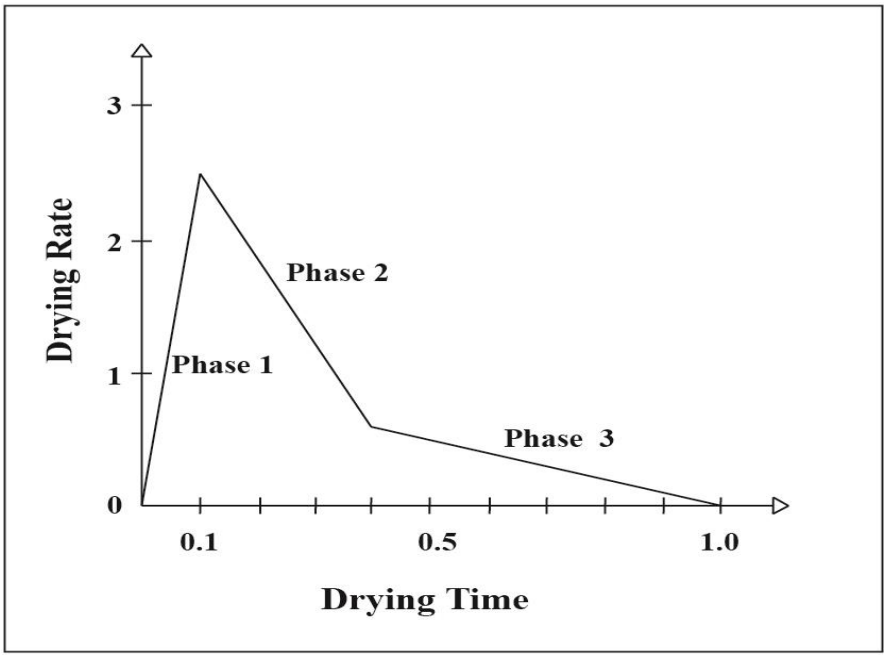


Figure 7. Phases of the drying process.
Source. (White & Cakebread, 1966).

2.1.1.3. Desorption

At this stage, the diffusion rate continues because the unfrozen water needs more energy to evaporate and is declined until it approaches zero (Figure 7). However, by increasing the temperature in the freeze-drying chamber in a range from 10 ° C to 70 ° C and keeping a low vapor pressure, the water bound to the food, between 10 % to 35 %, has not been sublimated is eliminated (Bacaoanu & Picos, 2005) (Benavente & Garcia, 1999). The water is eliminated by diffusion through the glassy phase, which implies a longer drying time. The volatile compounds present in the food are not affected by staying at these conditions of pressure and temperature due to the low humidity present in the product, which reduces the diffusivity of these compounds (Benavente & Garcia, 1999).

2.1.2. Industrial Facilities

An industrial freeze dryer essentially has a vacuum chamber and trays where the food to be vacuum freeze-dried is placed. Initially, the food is frozen in a cooling chamber, then the trays with the frozen food are placed in the vacuum chamber. The freeze-drying time varies with the type of food, the conditions of temperature, pressure in the chamber, and temperature on the product's surface.

Most industrial facilities have cold chambers separate from the freeze dryer to minimize the freezing time and benefit the stability of the food during the drying stage. However, there are also machines thoroughly equipment to do all these steps in just one chamber.

Figure 8 present the general process of vacuum freeze-drying a food. Initially, the food is prepared, then the wagons with the food are introduced to the chamber to be freeze, and then they are dehydrated in the vacuum conditions in the freeze-dryer. After a certain period, the wagons are removed, and the final product is packed instantly.

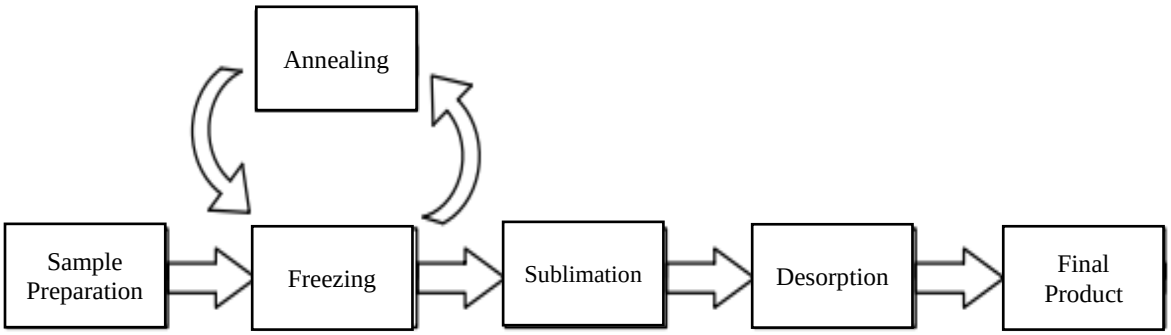


Figure 8. Description of the lyophilization process from preparation to packaging.

2.1.3. Advantages and Disadvantages of Freeze-Drying

Gaidhani (2015) and Martínez and Prada (2008) describe the advantages and disadvantages of using the freeze-drying process to dehydrate foods on an industrial level (Table 1). .

Table 1:Advantages and Disadvantages of Freeze-drying

Advantages	Disadvantages
• Oxidizable substances are well protected under vacuum conditions. • Long preservation period owing to 95 % - 99.5 % water removal. • Loading quantity accurate and content uniform. • Little contamination owing to the aseptic process. • Minimal loss in volatile chemicals and heat • Sensitive nutrient and fragrant components. • Minimal changes in the properties because microbe growth and enzyme effect cannot be exerted under low temperature. • Rapid reconstitution time. • The product is processed in liquid form. • Sterility of product can be achieved and maintained.	• High investment cost of facilities and equipment, approximately four times more than conventional drying • Attached facilities with high maintenance costs • Long times are required for the process • High energy expenditure

2.2. Business Model

Business model concepts have been mentioned, the main ones raised by Alexander Osterwalder and Yves Pigneur, Michael Porter, Arnoldo Hax, Selznik, and others. However, this project considers the concept mentioned by Osterwalder and Pigneur in their book *Generation of Business Models* (2010), who mentions that "A business model describes the rationale of how an organization creates, delivers, and captures value".

The following four types of business models have been identified, which are:

- Competitive Advantage Model by Michael Porter
- Model-based on the Resources by Philip Selznick
- Delta Model by Arnoldo Hax
- Canvas Model by Alexander Osterwalder and Yves Pigneur

2.2.1. Business Model Canvas

This model results from Alexander Osterwalder's doctoral research and directed by Yves Pigneur and published in 2004 (Osterwalder & Pigneur, 2010). This method consists of placing nine essential elements of a company on a canvas to mold the business idea following the building blocks technique that allows the entire model to be observed on a single page (Figure 9) (Blank, 2013). The way of presenting a company's business is simplified with the Canvas model, giving rise to value proposals that can be considered blue oceans (Kim, Mauborgne, & De Hass, 2005).

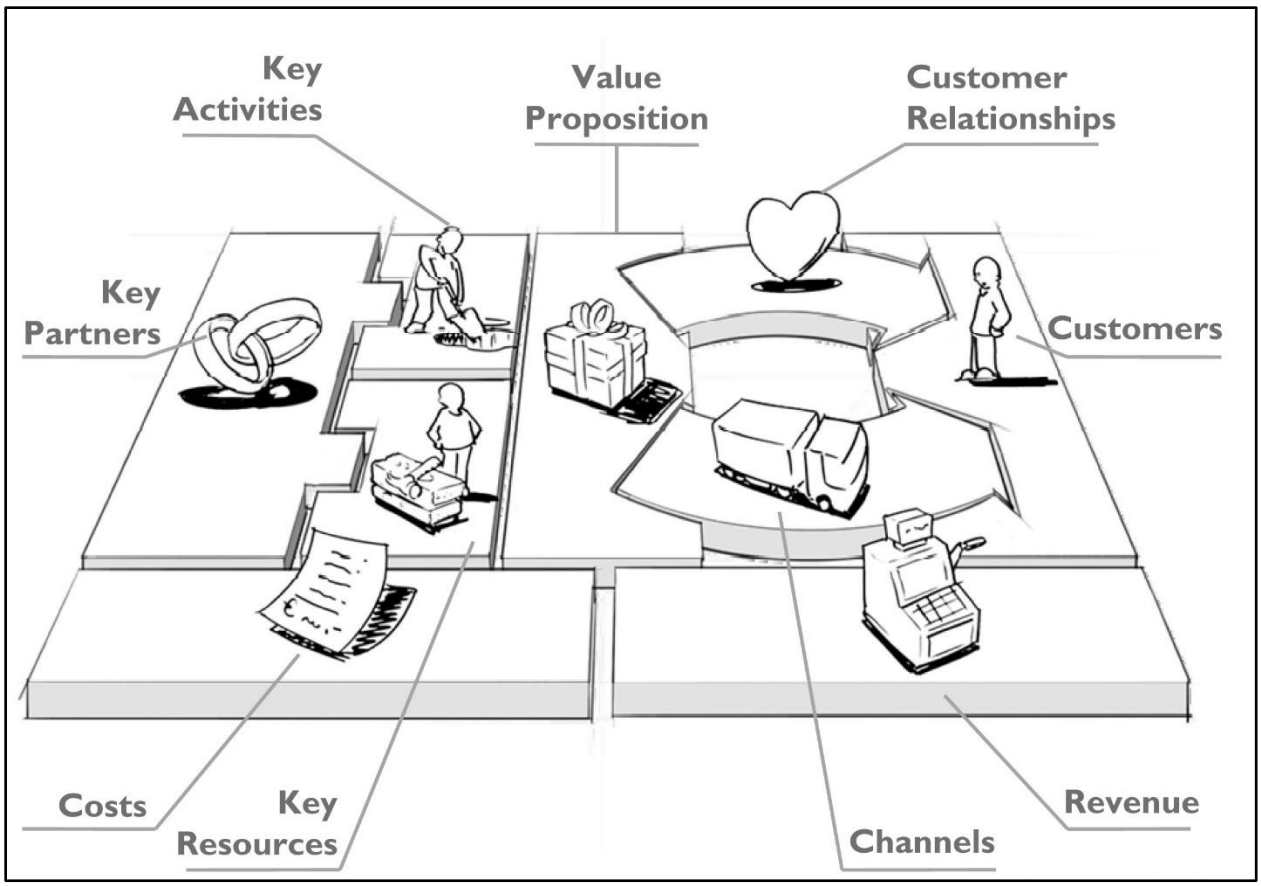


Figure 9. Business Model Canvas.
Source. (Osterwalder & Pigneur, 2010).

2.2.2. Components of a Business Model Canvas

Osterwalder and Pigneur, in their book Business Model Canvas (2010), mention that a business model has nine main components. These facilitate the interpretation and presentation of business models.

1. Value propositions
2. Customer segment
3. Customer relationships
4. Channels
5. Revenue streams

6. Key resources
7. Key activities
8. Key partnerships
9. Cost structure

2.2.2.1. Market Segment

According to Osterwalder and Pigneur (2010), the market segment facilitates the client's choice or group that a company aims to reach with its value proposition. Furthermore, the customer is the backbone of any business. However, they also mention that not all customers belong to the same segment; it differs when:

- Their needs require and justify a distinct offer
- They are reached through different distribution channels
- They require different types of relationship
- They have substantially different profitabilities
- They are willing to pay for different aspects of the offer

2.2.2.2. Value Proposal

The value proposal helps describe the products or services that a company wants to provide to a specific market segment. Similarly, the value proposition is defined as a factor or series of advantages that a company offers to the customer to choose over another company (Osterwalder & Pigneur, 2010).

On the other hand, a value proposition creates quantitative or qualitative value, new products, or services, to make the customer's life easier. Table 2 lists some elements that may favor value creation.

Table 2. Elements that favor the creation of value.

Elements	Description
Newness	Satisfy non-existent needs that the client does not appreciate because there is no similar offer
Performance	Increase performance on a service or product
Customization	Tailoring products and services to meet specific customer needs
Getting the job done	Help the client to perform certain jobs
Desing	It is an essential part of the value proposition
Brand / Status	Build value from the quality of the brand
Price	Important when considering a market segment that is governed by prices
Cost reduction	Help customers reduce costs
Risk reduction	Risk reduction for the acquisition of a service or product
Accessibility	Make products and services available to customers who previously did not have access to them
Convenience / Usability	Make things easier or more practical

Source. (Osterwalder & Pigneur, 2010).

2.2.2.3. Channels

Channels are the different ways a company can reach its customer segments and provide value (Osterwalder & Pigneur, 2010). These communication, distribution, and sales channels come to fulfill the following functions:

- Raisin awareness among customers about a company's product and services
- Helping customers evaluate a company's values proposition
- Allowing customers to purchase specific products and services
- Delivering a value proposition to customers
- Providing post-purchase customer support

2.2.2.4. Relationship with Clients

Companies must consider the best way to relate to their market segment, ensuring that the overall customer experience is the best. This relationship can be personal or automated and based on the fundamentals of stimulating sales, attracting, and retaining customers (Osterwalder & Pigneur, 2010). Table 3 describes various categories of customer relationships that a company can maintain with its market segment.

Table 3. Types of customer relationship categories.

Category	Description
Personal Assistance	The customer chooses to communicate directly with an actual customer service representative
Dedicated personal assistance	A real customer service representative is especially dedicated to a previously assigned customer
Self-Service	The company does not maintain a direct relationship with the client. It only offers the necessary means to help solve their concerns and problems
Automated services	Combine self-service with automated processes
Communities	Create online communities that allow customers to exchange knowledge and solve problems for other users
Co-creation	Enlist customer collaboration to create new value propositions

Source. (Osterwalder & Pigneur, 2010).

2.2.2.5. Revenue Stream

The sources of income, arteries of the business, refers to the cash flow generated by a company. These sources are classified as fixed and dynamic. Fixed sources are based on transaction income derived from customer payments (Osterwalder & Pigneur, 2010). On the other hand, dynamic sources are based on recurring income derived from periodic payments. According to market, volume, and profitability management, prices are based on auction

mechanisms, negotiations, fixed price lists, and profitability management (Osterwalder & Pigneur, 2010). Table 4 presents some of the various ways of generating sources of income for a company.

Table 4. Ways to generate sources of income.

Shapes	Description
Asset sale	Sale of property rights to a physical product
Usage fee	It is based on the use of a specific service
Subscription fees	It is based on the uninterrupted use of a certain service
Lending / Renting / Leasing	In exchange for a fee, it arises from the concession of a right to an asset for a certain time.
Licensing	It is the payment of a license to use any intellectual property
Advertising	Quotas for advertising a specific service, product, or brand.

Source. (Osterwalder & Pigneur, 2010).

2.2.2.6. Key Resources

According to Osterwalder and Pigneur (2010), the key resources consider the most relevant assets a company owns to create and offer a value proposition, reach markets, establish relationships with customers and receive income. These resources can be physical, economic, intellectual, or human (Table 5).

Moreover, the ease of identifying these key resources of an enterprise comes from considering the following questions:

- What key resources do our value propositions require?
- Our distribution channels?
- Customer relationships?
- Revenue Streams?

Table 5. Key resource types.

Resources	Detail
Physical	- Manufacturing facilities - Buildings - Vehicles - Machines, - Systems - Points of sale - Distribution networks
Intellectual	- Trademarks - Private information - Patents - Copyright - Associations - Customer database
Human	- Human Resources
Financial	- Cash - Credit lines - Stock portfolio

Source. (Osterwalder & Pigneur, 2010)**.**

2.2.2.7. Key Activities

Osterwalder and Pigneur (2010) consider that the activities class focuses on the most relevant actions that a company must execute to succeed with its business model. These activities are essential for creating and delivering a value proposition, reaching markets, establishing customer relationships, and earning income.

The key resources are divided into:

- Production: Activities related to the design, manufacture, and delivery of products
- Problem Solving: Information management and continuous training
- Platform / Network: Management of software, networks, and contact platform

2.2.2.8. Key Associations

The key associations are the relationships that a company establishes with other private or public companies to create alliances to optimize its business models, reduce risks, or acquire resources (Table 6). In this sense, the mean kinds of associations are Strategic Alliances, Competition, Joint Venture, and Customer-Supplier Relations (Osterwalder & Pigneur, 2010).

Table 6. Motivations and benefits of establishing partnerships between companies.

Motivations	Benefits
Optimization and economy of scale	- Optimization of resources and activities - Production cost reduction - Infrastructure Outsourcing
Reduction of risk and uncertainty	- Loss decrease - Decrease of inserting in new research - Low risk in new projects
Acquisition of particular resources and activities	- Shared resources - Increase in production capacity - Access to information, licenses, or clients

Source. (Osterwalder & Pigneur, 2010).

2.2.2.9. Cost Structure

The cost structure describes all the capital that is needed to run a new business model. The main costs come from creating and delivering value, maintaining customer relationships, or generating income. In turn, two cost structures are distinguished: according to costs and according to value (Osterwalder & Pigneur, 2010).

Cost-based businesses prioritize cutting expenses using automated systems, high outsourcing, and low-priced value propositions. On the other hand, companies that do not follow this model focus on creating value (Osterwalder & Pigneur, 2010). Table 7 describes the characteristics of the cost structures.

Table 7. Characteristics of cost structures.

Characteristic	Description
Fixed cost	It does not vary depending on the volume of production
Variable costs	It varies proportionally to the volume of production
Economies of scale	It favors the decrease of the average cost per unit
Economies of scope	The field of action that a company has increases

Source. (Osterwalder & Pigneur, 2010).

2.2.3. Stages of the Business Model

According to Osterwalder and Pigneur (2010), the process of creating a business model consists of five stages:

i) Mobilization: Consists of preparing a successful business model design project.

ii) Comprehension: It is necessary to investigate and analyze the elements necessary for the design of the business model.

iii) Design: It is the stage where the business model is adapted and modified according to the market response.

iv) Application: In this stage, it is crucial to execute the selected business model prototype.

v) Management: It is essential to make an adaptation and final modification of the selected model according to the market's reaction.

2.2.4. Difference between Business Model and Business Plan

The terms business model and business plan are sometimes associated; however, they are different concepts. Alternately, a business model is a tool that helps to establish the bases that validate a business idea, which helps to delimit and define, in a strategic sense and how a company will operate. On the other hand, the business plan defines the main business

objectives based mainly on the validated business model. To execute the plan following the reality of the market and in the environment where the company will operate (Varela & Zapata, 2015).

Business Model Canvas is a relevant tool in the context of entrepreneurship and innovation, and its importance lies in its simplicity of interpretation; the business can be captured on a single page (Ferreira, 2015). This methodology helps to visualize, through nine blocks, the internal and external aspects that a company handles, facilitating the validation of the business idea. Also, it is essential in the design stage of a business plan (Chaguay, Flores, Bayas, & Zapata, 2019).

2.3. Economic Evaluation Methods

Project economic evaluation methodologies have been widely studied due to their ability to predict economic viability. These methods can determine the possible failure by comparing the necessary investment with the potential economic income that the company will obtain (Götze, Northcott, & Schuster, 2008). In this context, Gotze, Northcott, and Schuster (2008) present a general guide to the classification of the economic evaluation methods of a project (Diagram 1). The classification goes in descending order and according to the complexity of the economic evaluation method. To this study is considered the Discounted Cash Flow Method to determine the economic project viability.

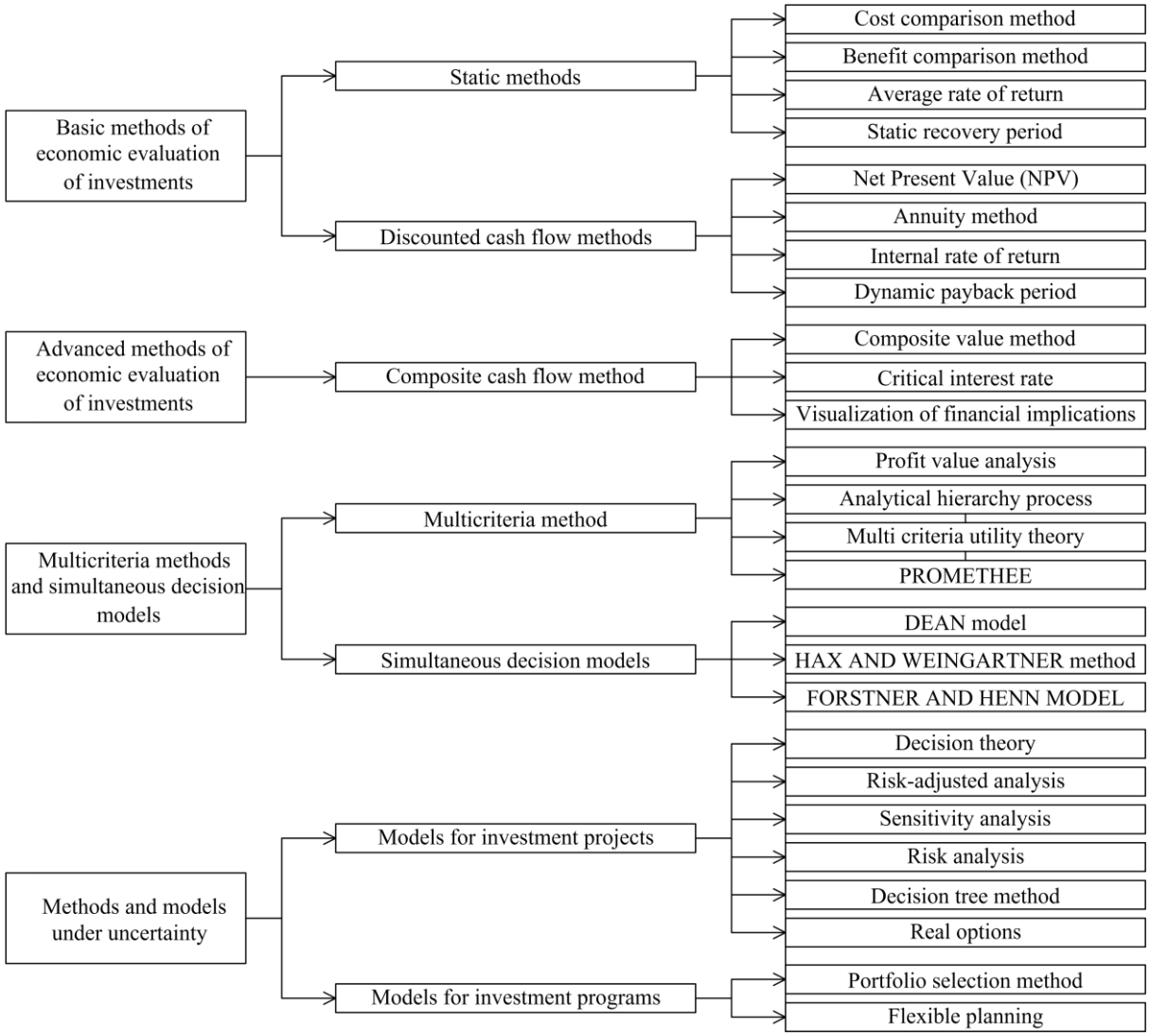


Diagram 1. Classification of methodologies for the economic evaluation of projects.
Source. (Götze, Northcott, & Schuster, 2008).

2.3.1. Discounted Cash Flow Method

It is a method of the economic evaluation of a basic type where the flow of money over time under conditions of certainty begins to be considered. The most common methods are present net value (NPV), internal rate of return (IRR), annuity method, and the recovery period (Götze, Northcott, & Schuster, 2008). In this research, they only consider three of them.

2.3.1.1. Net Present Value (NPV)

The net present value (NPV) is a dynamic economic evaluation technique that presents the discounted cash flows generated during the project's life and then compares this equivalence with the initial disbursement (Götze, Northcott, & Schuster, 2008). If the calculated net present value is greater than zero, the investment should be made; instead, reject it if this value is negative (Bradford , Ross, & Westerfield, 1996). For a project with N periods, the NPV is calculated according to the following equation.

$$NPV(I,N) = \sum_{t=0}^{N} \frac{R_t}{(1+i)^t} \quad \textbf{(1)}$$

Where:

$\boldsymbol{R_t}$ *is the net cash flow*

$\boldsymbol{t}$ is the time of the cash flow

$\boldsymbol{i}$ is the discount rate

NPV is one of the simplest methods to determine economic viability due to the low difficulty of its calculations. For this reason, this method is one of the most used to theoretically evaluate the feasibility of investment (Cardona & Forero, 2012).

2.3.1.2. Internal Rate of Return (IRR)

The internal rate of return is an index of return. It is defined as the interest rate that leads to an NPV equal to zero when applied as a uniform discount rate (Götze, Northcott, & Schuster, 2008). Based on this, investment is acceptable if the IRR is greater than the required return; otherwise, the investment is not made (Bradford , Ross, & Westerfield, 1996).

When considering the IRR or in Equation 1, it is observed that r cannot be solved. Because of this, an approximation is made where r * equals r. The following equation is obtained by interpolation to determine the r* value as an approximation to r.

$$r^* = r = i_1 - \left(\frac{NPV_1}{NPV_1 - NPV2_2}\right)(i_2 - i_1) \quad \textbf{(2)}$$

Where:

$\boldsymbol{i_1}$ *is an arbitrarily selected discount rate*

$\boldsymbol{i_2}$ *is an arbitrarily selected discount rate*

Götze, Northcott, and Schuster (2008) mention that the IRR is analogous to the NPV and therefore, the two are subject to the same application and functionality considerations.

2.3.1.3. Recovery Period

The recovery period is when the net income arising from the net cash flow reaches the value of the initial investment required. For its application, all cash flows must be considered throughout the life of the project. Götze, Northcott, and Schuster (2008) propose the following formula for its calculation.

$$Recovery\ period = t^* - 1 + \frac{VPN_{t^*-1}}{VPN_{t^*-1} - VPN_{t^*-1}} \quad \textbf{(3)}$$

CHAPTER III

3. PRELIMINARY ANALYSIS

3.1. Current situation

3.1.1. Economic Environment

According to the Central Bank of Ecuador, the year 2020 ended with a drop in gross domestic product (GDP) of - 8.8 % , however, International Monetary Found mention that value is -9.5 % (Figure10). The fall in the Gross Domestic Product was caused by the decrease in gross fixed capital formation, household, and government consumption expenditures, in addition to the decrease in imports of goods and services (Figure 11). The effect of the global COVID-19 pandemic being the main reason for this contraction of the country's economy (Central Bank of Ecuador, 2020).

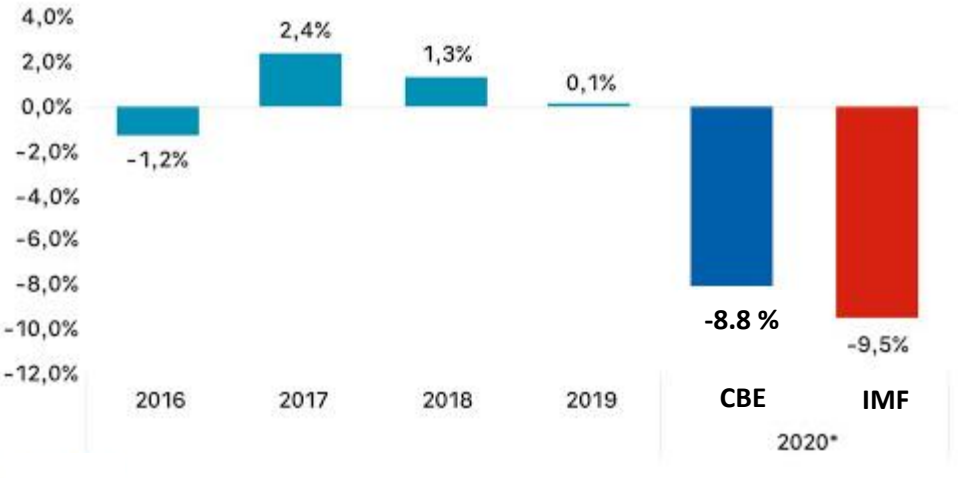


Figure 10. Rates of quarterly variation of Gross Domestic Product (GDP).
Source. (Central Bank of Ecuador, 2020).

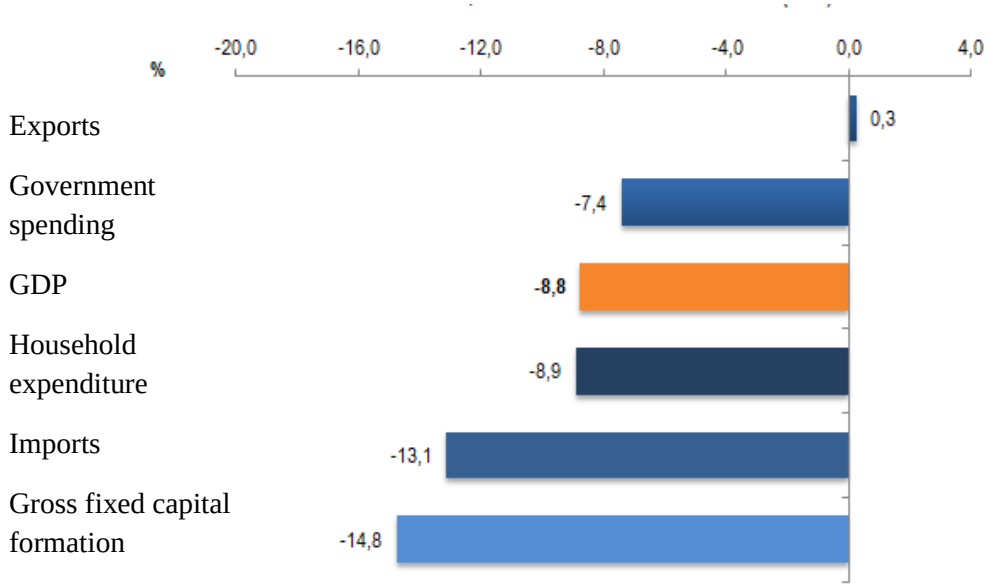


Figure 11. Offer and use of goods and services.
Source. (Central Bank of Ecuador, 2021).

However, in its 2021 World Economic Outlook report (2020), the World Bank presented its estimates of Ecuadorian GDP, and in it, the GDP shows recovery and growth of 3.1 %. Being a reflection of the increase of 1.1 billion in exports, of 936.6 in imports, and 114 million in private investment, likewise, with a decrease of 171.2 million in public investment (Figure 12) (Central Bank of Ecuador, 2020).

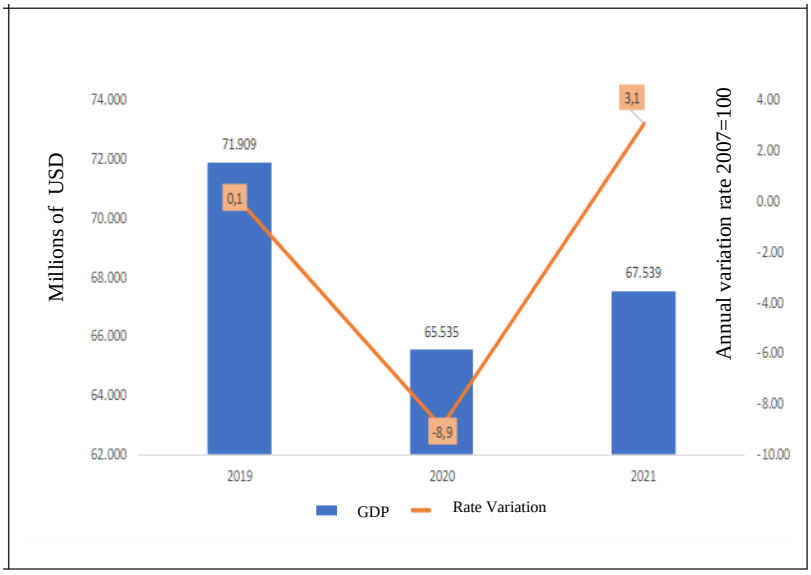


Figure 12. Estimated Gross Domestic Product (GDP) for 2021.
Source. (Central Bank of Ecuador, 2020).

On the other hand, the unified basic salary was USD 400, with an increase of 6 % compared to 2019. Besides, in 2020 it ended with annual inflation, compared to December 2019, of -0.93 %. As a result, the basic family basket cost USD 710.08, with the average family income covering 105.15 %. Likewise, the life basket cost was USD 500.79, being covered, by 149.10 %, by the average family income (INEC, 2020).

3.1.2. Legal Environment

The Ecuadorian constitution of 2008 contemplates the following laws in favor of companies.

3.1.2.1. Organic Law for Productive Development

In August 2018, the National Assembly approved the draft Organic Law to promote production, Attraction of Investments, Generation of employment, and Stability and Fiscal Balance. This project presents seven fundamental axes to encourage private investments to generate employment in the country, which is mentioned below:

- Strengthening of PYMES and entities of the popular and solidarity economy

- Incentives for attracting private investment and generating employment
- Reforms that promote a clear legal framework that encourages private activity and employment
- Remission of interest penalties and surcharges
- Development-focused reforms
- Reforms to strengthen the export and tourism sector
- Other reforms

These axes have incentives that will benefit new companies or those already existing during the project execution stage and subsequent operation. Table 8 presents a summary of the main incentives.

Table 8. Incentives of Organic Law for Productive Developed.

Axis	Benefit
Strengthening of MSMEs	Deduction for training and production improvement, from 1 % to 5 % for wages and salaries
Incentives to attract investment	Income tax exemption and your advance. In Quito and Guayaquil for 8 years, and cities of the rest of the country for 12 years.
Reforms that promote a clear legal framework	Elimination of the minimum payment of the income tax advance
Reforms focused on strengthening	Refund of the ISD for habitual exporters in importing raw materials, supplies, and capital goods.
Other reforms	0 % VAT rate on imports and transfer of inputs from the agricultural sector.

Source. (INEC 2019).

3.1.2.2. Organic Law for the Regulation and Control of Market Power

In November 2020, the Ecuadorian National Assembly approved the new Organic Law for the Regulation and Control of Market power to establish a supportive and sustainable social-

economic system. The main objective is to avoid, prevent, correct, and eliminate the abuse of companies that have significant market power. Also, it seeks to prohibit and sanction unfair practices that do not seek the welfare of consumers and users.

3.1.3. Technological Environment

3.1.3.1. Transport

By 2020, according to the Ministry of Transport and Public Works (2021), the national primary and secondary road network comprises a total of 10,285.6 km. The quality of these road networks' system is the second-best in Latin America (Financial Advisory, 2019). 67 % are in good condition, and 33 % need maintenance (Ministry of Transport and Public Works of Ecuador, 2021). The main first-order roads that facilitate trade and development are the Pan-American Highway, the Espondilus Route, and the Amazon Trunk.

In the air sector, according to Ecuadorian civil aviation, the country has 21 operating airports. However, only José Joaquín de Olmedo and Mariscal Sucre International airports have concession permits to provide international cargo due to the global health emergency of COVID-19 (General Directorate of Aviation Civil, 2020).

On the other hand, the maritime cargo transport sector is one of the main trade axes in the country. According to the Maritime Chamber of Ecuador, (2019), the country has 5 ports on the coasts of the Pacific Ocean: Puerto de Manta, Puerto de Guayaquil, Puerto Bolívar, Puerto de Esmeraldas and Puerto Posorja. The Port of Guayaquil mobilizes 85% of international trade transactions, thus becoming the most important port in the country (Cámara Marítima del Ecuador, 2019).

3.1.3.2. Industry

The industrial sector plays a fundamental role in Ecuador's economy, so during the period from 2016 to 2020, the non-oil manufacturing sector contributes 12 % to GDP and the oil sector an average of 10 % to GDP (Chamber of Commerce of Guayaquil, 2020). However, this sector was also affected by the humanitarian crisis of COVID-19, reducing its income by 6.8 % in the non-oil industrial sector and by 11.5 % in the oil sector. (Central Bank of Ecuador, 2020).

About the non-oil sector, few industries grew in terms of their contribution to GDP. Among them, the food industry at 1.4 % and the tobacco industry at 15.1 %. Nevertheless, the industries most affected and suffered a setback in their growth were: the transport equipment manufacturing industry at -34.2 %, the manufacturing industries of other non-metallic products such as cement and glass at -19.5 % (Table 9) (Central Bank of Ecuador, 2020).

In 2016, to strengthen the local industry and strengthen the development of Ecuador, a plan called "The industrial policy of Ecuador from 2016 to 2025" was approved. These policies are aligned with the “Plan Nacional del Buen Vivir” objectives to achieve the goals sets.

These policies base their strategy on the following aspects:

- Strengthening of local chains
- Export Orientation
- Strategic Substitution to Imports

Table 9. Summary of non-oil industrial sector income in 2020.

	2019-2020
Processed foods	+1.4 %
Preparation of beverages	-6.3 %
Tobacco production	+15.1 %
Processing and paper products	-2.7 %
Manufacture of other non-metallic mineral products	-19.5 %
Manufacture of base metals and metal-derived products	-13.3 %
Manufacture of machinery and equipment	-12.5 %
Manufacturing of transportation equipment	-34.2 %
Furniture manufacturing	-3.2 %
Manufacturing industries NCP	+2.5 %

Source. (Central Bank of Ecuador, 2020).

In turn, the government is promoting the project to change the productive matrix of Ecuador, which is also aligned with the objectives of the "Plan Nacional del Buen Vivir". The transformation of the production matrix implies moving to a diversified, eco-efficient production with more excellent added value. According to the National Secretariat for Planning and Development, the axes to achieve these objectives are:

- Productive diversification is based on the development of strategic industries-refinery, shipyards, petrochemicals, among others.
- Adding value to existing products through the incorporation of technology and knowledge in current biotechnology, environmental services, and renewable energy production processes
- Selective substitution of imports with goods and services that we currently produce and that can be substituted in the short term.

- The promotion of new products, coming from new players, particularly from the popular and solidarity economy, or that include greater added value in fresh and processed foods, clothing, footwear, and tourism.

3.1.3.3. Socio-Cultural Environment

According to the INEC (2021), for the first semester of the year 2021, the Ecuadorian population is 17.4 million inhabitants distributed in the 24 provinces of Ecuador. Guayas and Pichincha are the provinces with the highest number of inhabitants, with more than 4.3 million and 3.2 million, respectively (Table 10). Besides, according to the World Bank (2018), the life expectancy of Ecuadorians is 76.8 years.

Table 10. Ecuador's population distribution by provinces.

Ecuador Population							
Costa		**Sierra**		**Amazonia**		**Insular**	
Province	**People**	**Province**	**People**	**Province**	**People**	**Province**	**People**
Esmeraldas	643,654	Carchi	186,869	Sucumbíos	230,503	Galápagos	33,042
Santo Domingo	458,580	Imbabura	476,257	Orellana	161,338		
Manabí	1,562,079	Pichincha	3,228,233	Napo	133,705		
Los Ríos	921,763	Cotopaxi	488,716	Pastaza	114,202		
Santa Elena	401,178	Tungurahua	590,600	Morona Santiago	196,535		
Guayas	4,387,434	Chimborazo	524,004	Zamora Chinchipe	120,416		
El Oro	715,751	Bolívar	209,993				
		Cañar	281,396				
		Azuay	881,394				
		Loja	521,154				

Source. (INEC, 2020).

3.2. Market Research

3.2.1. Method

For the development of the business model of the vacuum freeze-drying plant, non-experimental research was carried out to recollect information with an objective look in the natural context. After this, the information obtained was analyzed. Besides, the research was transversal with a descriptive proposal because all information was recollected simultaneously. All information helped to elect the Canvas methodology to create a new model business because it is a simple tool that facilitates the conceptualization of a business model. In turn, this tool allows the design of new scenarios that the company may have.

The canvas model served as a base to design the scheme of the lyophilization plant and its mass process diagram. For this design, bibliographic research was carried out to identify the fundamental processes for the proper functioning of a lyophilization plant. Then, using the deductive method, the general mass balance of the lyophilization process was carried out considering a steady state during all stages. Also, the financial study was realized electing a deductive methodology was chosen. The most used indicators for project evaluation were identified: NPV, IRR, and R / C. Then, through a field and bibliographic study, the necessary data were obtained to carry out the evaluation using these indicators and determine the project's economic viability.

3.2.2. Techniques

For the elaboration of this research, activities were carried out in the following established order.

Business Model Canvas

The stages of the Canvas and their associated factors

Surrounding analysis

- Market Segment: Descriptive techniques were used through the use of tables, surveys and interviews.
- Segmentation: Variables like location, economic income, age, and feeding habits.
- Demand: A statistical study considering a proportional sample was done to establish both the demand and the purchase frequency.

Analysis of the vacuum freeze-drying process

- The fundamental stages of the lyophilization process were identified by reviewing the literature.
- Through mathematical calculations, the general mass balance of the process was carried out
- Through computer-aided design, the process scheme and block diagram were made.

Financial evaluation

Economic indicators: NPV, IRR, and R / C

3.2.3. Instruments

Among the main instruments, we use for the research are the INEC database, Central Bank of Ecuador database, decentralized autonomous governments' database and questionnaires.

3.2.4. Population

The population is established by the two market segments that the company has: Service and sale of assets.

3.2.4.1. Service

In this area, inclusion criteria were established to determine the market segment. Initially, considering the information from the territorial development plans of the cantons of Cayambe, Otavalo, and Pedro Moncayo, the people who obtain their income from agricultural activity were integrated. Then, the inclusion criterion of the quantity of agricultural area greater than 1000 m^2. After, the kind of agriculture product: strawberry. Finally, it was realized a verification of these variables through a personal toured for these zones and 100 farmers who met all of these characteristics were identified.

Subsequently, the sample size was determined to carry out the questionnaire using the proportional sampling equation (Equation 4) ((Bernal , 2000).

$$n = \frac{Z_{x/2}^2 . PQN}{\varepsilon^2 (N-1) + Z^2 PQ} \quad (4)$$

Where:

n = Sample size required

Z = Margin of reliability

P = Probability of the event occurring

Q = Probability that the event will not occur

ε = error

N = Population size

The values were z = 1.96, P = 0.5, Q = 0.5, ε = 0.05 and N = 100, to obtain a sample size (n) of 80 people.

3.2.4.2. Sale of Assets

About this customer segment, the inclusion criteria were again determined. With this, every economically active person in the city of Quito is included. More include people between the ages of 20 and 39 who belong to this population's middle and upper class. Finally, people with healthy eating habits are included. As a result of this, was identified 190,701 persons as the population.

Subsequently, the sample size was determined to carry out the questionnaire using the proportional sampling equation (Equation 4). The values were $z = 1.96$, $P = 0.5$, $Q = 0.5$, $\varepsilon = 0.05$ and $N = 190,701$, to obtain a sample size (n) of 383 people.

3.2.5. Information Sources

The information sources used in this research are primary and secondary.

3.2.5.1. Primary Sources

Interviews were conducted with farmers from Cayambe, Otavalo, and Pedro Moncayo cantons as primary sources for this research. Besides, surveys were also applied from the Quito population. With this, it was possible to obtain relevant information for the development of the business model proposal.

3.2.5.2. Secondary Sources

The compilation of information necessary for this research has, like principal component, the bibliographic sources that have a relationship with business models, freeze-drying processes, and project evaluation. These can be books, publications in scientific journals, and reports from national institutions such as the INEC databases, the Central Bank of Ecuador, and the Decentralized Municipal Autonomous Governments.

3.2.6. Results and Interpretation

In this context, the results of the interviews were performed with the farmers in Cayambe, Otavalo, and Pedro Moncayo cantons. Besides, the results of the surveys to the citizens of Quito corresponding to the market segment that was determined are presented.

3.2.6.1. Farmers Survey

According to the sample size, 80 interviews were conducted with strawberry farmers in the Cayambe, Otavalo, and Pedro Moncayo areas (Appendix B.1). The objective of these interviews was to determine the marketing system for strawberries produced by farmers in these locations. With the identification of farmers' preferences, the aim is to design a business model that helps this sector. In the first instance, it was determined that farmers allocate a significant amount of land for strawberry cultivation. These areas range from 1 / 4 ha to 2 ha. The results show that 32.5 % of the farmers use 1 / 3 ha, although very closely, 31.3 % of them use 1 / 2 ha. Then, 23.8 % of them allocate 1 / 4 ha for the cultivation of this fruit. On the other hand, 6.3 % use 1 hour, and only 6.1 % use land with areas greater than 1ha (Figure 13).

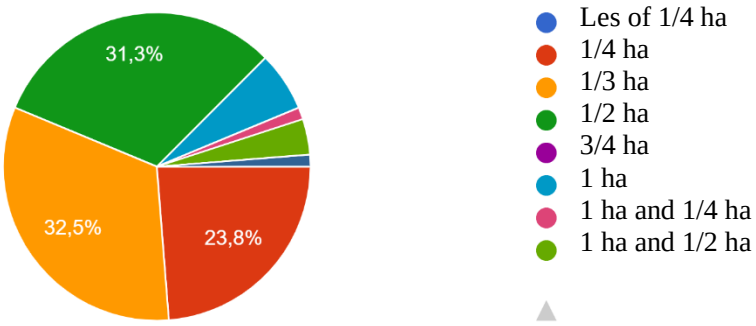


Figure 13. Area of land destined for the cultivation and production of strawberries.

These results helped determine that between Cayambe, Otavalo, and Pedro Moncayo, the total area destined for strawberry production is greater than 40 ha. They are reaching an average

strawberry production of more than 300 tons/month. Also, it was identified that 100 % of this production is sold to a person who acts as an intermediary between farmers and food processing companies, markets, supermarkets, among others (Figure 14). The packaging used by all farmers to sell the fruit is 12 kg buckets.

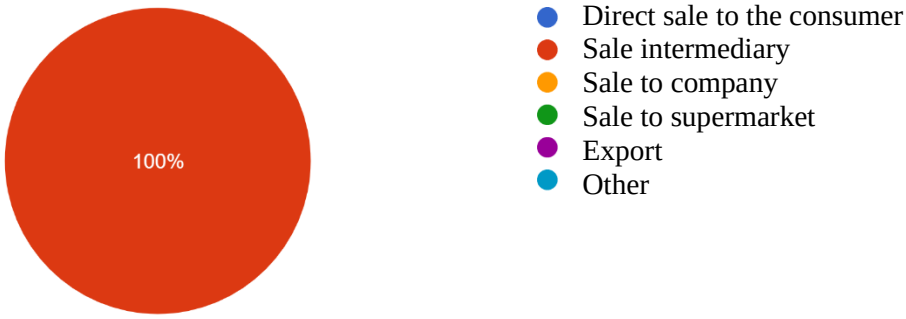


Figure 14. Way of strawberry marketing elected by farmers.

Also, it was identified that there are several intermediaries in these areas, and each one of them buys strawberries from farmers at different prices. Thus, the intermediary buys from 71.3 % of the farmers, for a value of 17.00 USD, the "special" quality strawberry. The remaining 28.7 % of them receive 18.00 USD for this quality of strawberry (Figure 15).

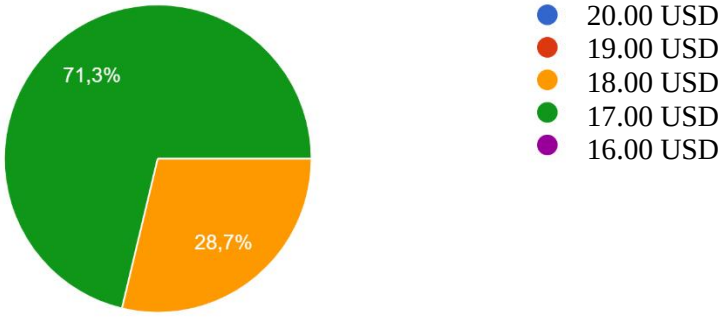


Figure 15. Price of a bin of strawberry (12kg): Special quality.

Figure 16 shows prices of first, second, and third quality of strawberry. For the "first" quality strawberry, 58.8 % of the farmers receive 14.00 USD for its sale. 40 % of them receive 15.00 USD, and only 1.3 % of them sell their product for 16.00 USD. Then, intermediaries pay for the "second" quality strawberry a value of 9.00 USD to 38.7 % of the farmers. 36.3 % of them receive 10.00 USD, 23.8 % receive 8.00 USD, and only 1.3 % receive 11.00 USD from selling their strawberry. Also, it was identified that there is greater convergence in prices for the "third" quality strawberry; 94.9 % of farmers receive 5.00 USD, 3.8 % receive 4.00 USD, and only 1.3 % receive 6.00 USD for the sale of this quality of strawberry.

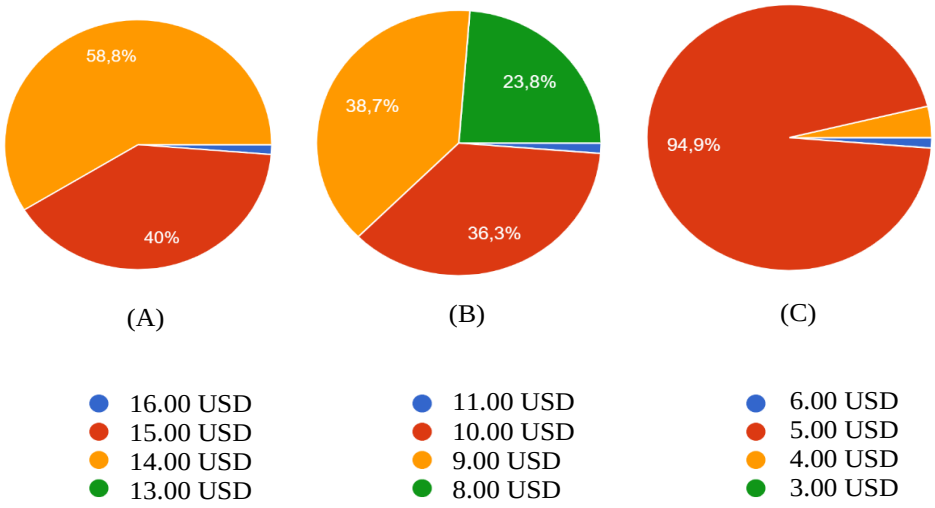


Figure 16. Prices of Strawberry (12kg). (A) 1° Quality, (B) 2° Quality, (C) 3° Quality

In this instance, dissatisfaction of the farmers was identified with the prices that the intermediaries pay for their product. Thus, 86.3 % of them consider that the sale price of strawberries is not fair. However, there are 13.8 % of them agree with the current price of their product.

Besides, the vast majority of farmers mentioned that the current price of strawberries was unfair. Thus, the main reasons are the high expenditure on maintenance of the crops and the

high risk of these crops due to the fragility of the plant to pests and climatic seasons (Figure 17). Then there is the significant damage to the soil due to the high use of agrochemicals, high expenditure on labor, high water consumption, and the high time spent maintaining these crops.

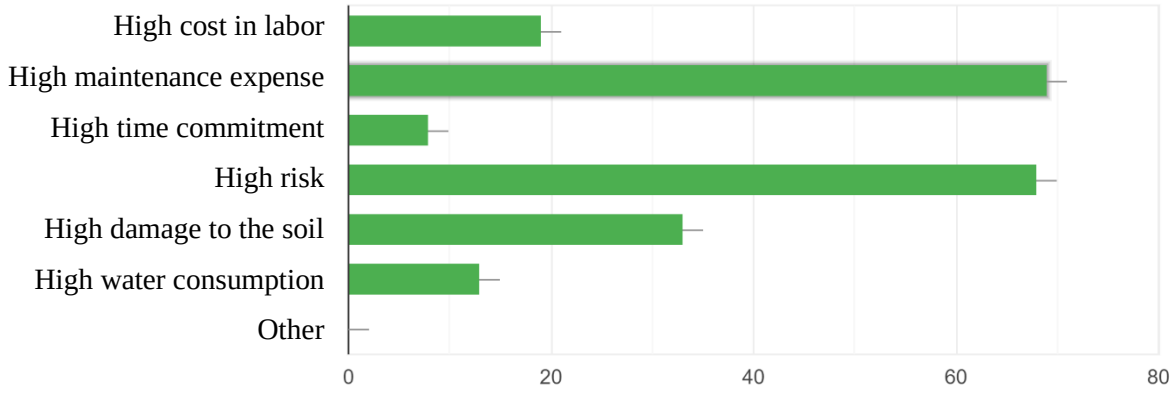


Figure 17. Reasons for unfair strawberry prices, according to farmers.

Besides, it was identified that there is a price fluctuation throughout the year. 95 % of farmers experience a price change rarely, and 5 % are occasionally affected. The main reasons for this problem are offer increase, decrease in demand, and excuses from the intermediary, which has caused the decrease in strawberry prices. On the other hand, as the last option, they consider that prices increase due to the decrease in winter supply (Figure 18).

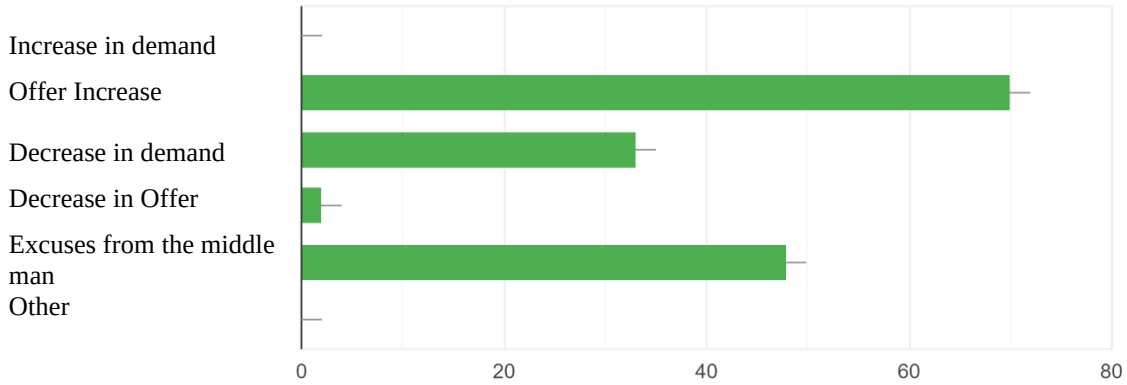


Figure 18. Reasons for price variation according to strawberry farmers.

Besides, it was identified that all farmers only sell the fruit fresh, not as a value-added product. 100 % of farmers do not process their strawberries to make derivative products such as jellies, jams, and pulps (Figure 19). Also, it was known that intermediaries buy this fruit directly from the farms of all farmers.

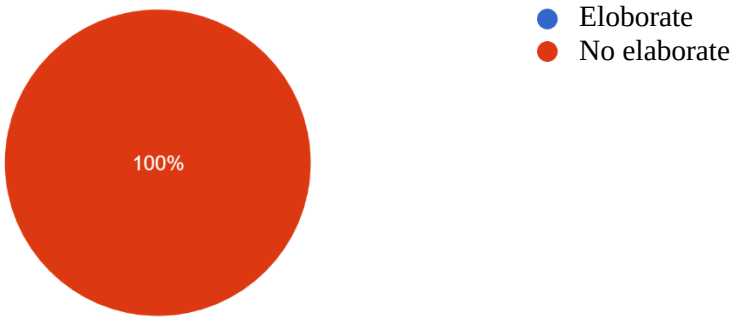


Figure 19. Percentage of farmers that make products from strawberries.

However, all farmers mentioned doing the sorting process after harvest. Although, none of them wash or disinfect the fruit at this stage. The way they classify the fruit is manual, and they allocate between 3 to 7 hours for this stage (Figure 20). Also, it was specified that a person classifies a maximum of 60 kg of strawberry in 1 hour.

Figure 20. Type of classification adopted by farmers.

Besides, 55 % of farmers have the predisposition to opt for a sorting service using machinery to reduce costs and time. However, 45 % of the strawberry producers mentioned being comfortable with their classification method because their production did not exceed 300 kg per harvest (Figure 21).

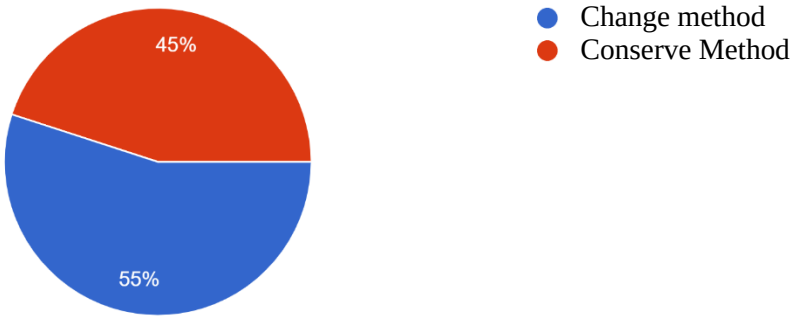


Figure 21. Percentage of strawberry farmers who want to change the sorting method.

Finally, 55 % of the people who want to opt for another classification method want to generate minimal expenses at this stage. That is why everyone was inclined to pay in a range of 0.02 coins to 0.03 coins per kilogram of classified strawberry (Figure 22).

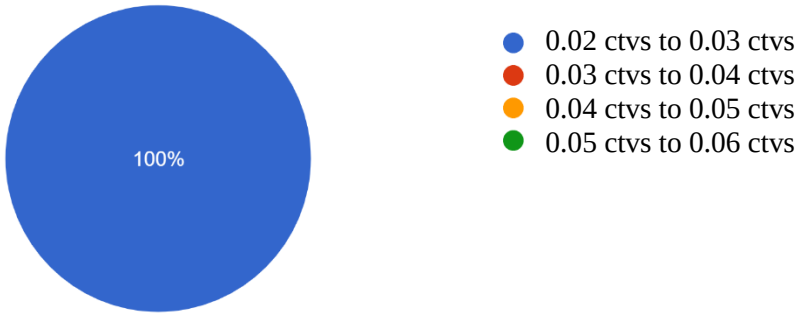


Figure 22. Percentage of strawberry farmers who want to change the sorting method.

3.2.6.2. Market Segment Survey

According to the sample size, 383 surveys were carried out among the population of Quito with an age of 20 to 39 years (Appendix B.2). The objective is to know market segment opinion about the characteristics of a healthy product, vacuum freeze-dried food, in Quito city. As a result of identifying the preferences of the market segment, the aim is to design a business model that helps this population maintain a good diet. In the first instance, people with healthy eating habits were identified, and that all of them consume dehydrated food at least once a month. Most of these people preferred dehydrated foods like fruits and cereals. While in a lower percentage of consumption are vegetables, meats, and sausages (Figure 23).

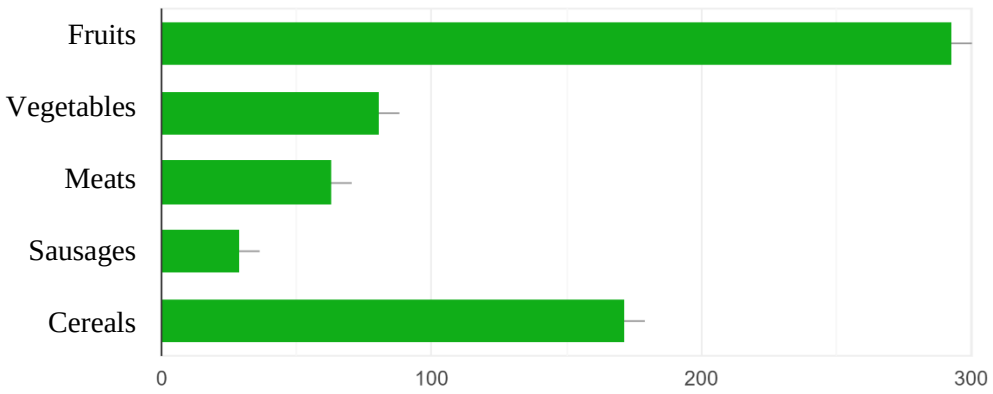


Figure 23. Dehydrated food consumption trend in the market segment.

Besides, our market segment's frequency of consumption corresponds to 28.4 % weekly, 27.4 % monthly, and 24.2 % consumes it daily. The amount of product consumed by the largest number of people, 25.2 %, corresponds to 20 g. Then, 19.2 % opt for 25 g and 50 g, 16.2 % for 15 g and 12.7 % for 10 g. In lower percentages, it consumes quantities greater than 50 g (Figure 24).

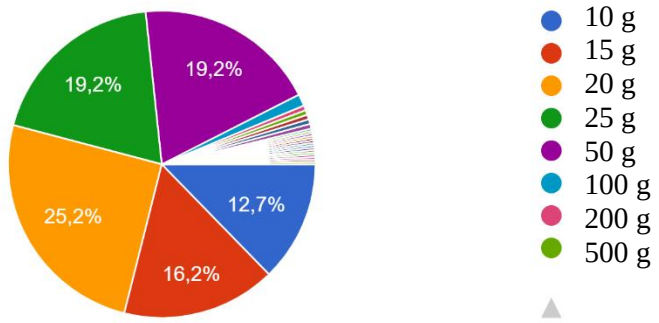


Figure 24. Cantidad en gramos de consumo de alimentos deshidratados.

Then, it was identified that the vast majority of the market segment buys dehydrated products in supermarkets. Also, stores and minimarkets are chosen as places to buy these products. To a lesser extent, specialized stores, pharmacies, and other places are chosen (Figure 25).

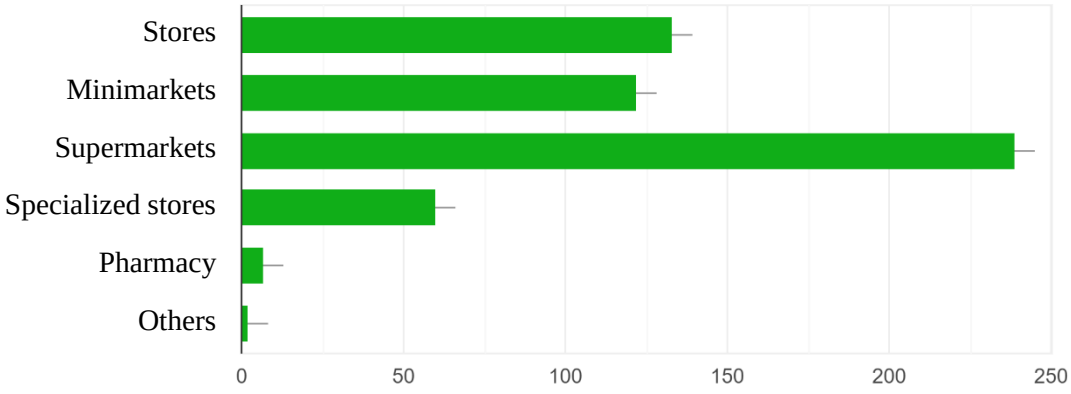


Figure 25. Places are chosen to buy dehydrated products.

Besides, 55 % of people choose to consume these foods at home. 20 % commented that they frequently consume at work. 18 % choose to consume it in an educational center. Finally, 8 % consume after doing physical activity in the gym (Figure 26).

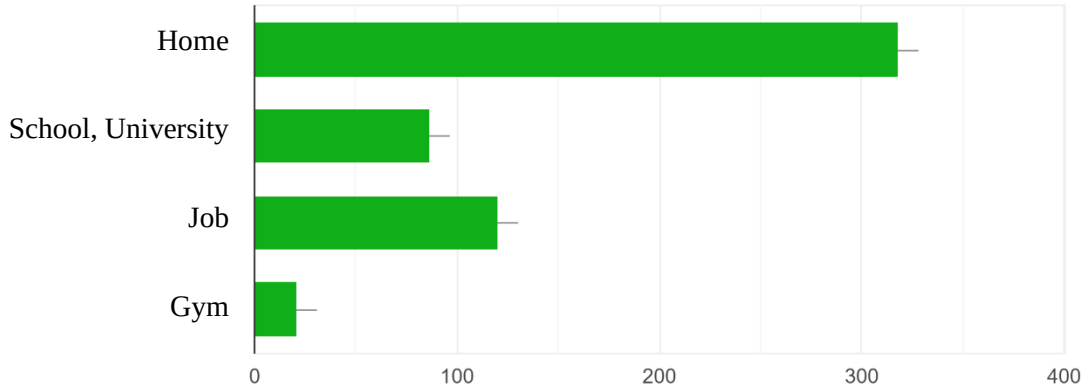


Figure 26. Chosen places to consume dehydrated food.

Then, 63.2 % of the market segment does not know about lyophilized products, and only 36.8 % of them know this type of product (Figure 27). Also, 73. 8 % of the market segment do not know about the properties of a lyophilized product, and only 28.7 % of them mentioned knowing the beneficial properties that these foods have.

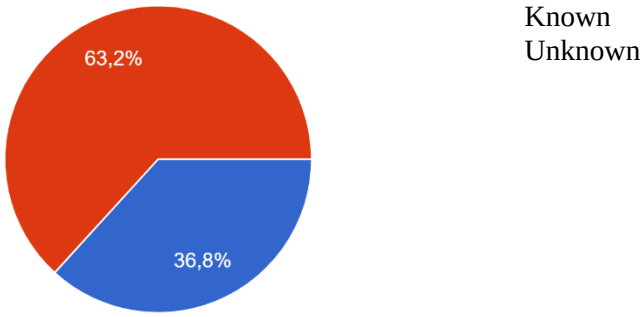


Figure 27. Percentage of the population that knows about freeze-dried food.

Subsequently, the preference of the freeze-dried fruits that the segment would like to have within reach was determined. On this basis, the strawberry had an acceptance in 58.3 % of the market segment, apple with approval of 50.5 %, mango with 47.2 %, pineapple with 40.3 %,

and cherries with 39.1 % acceptance. Also, the following fruits have less than 36 % of acceptance: banana, orange, grape, watermelon, coconut, and melon (Figure 28).

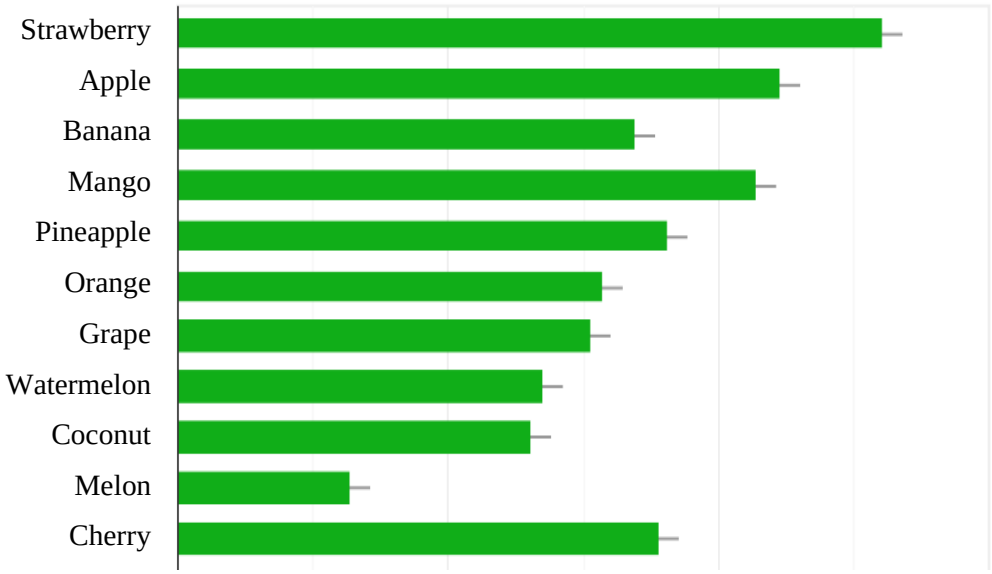


Figure 28. Freeze dried fruit choice trend.

In turn, the possible price ranges that the market segment would agree to pay for a freeze-dried product of 18 g were defined. The most widely accepted price was from 0.75 USD to 1.00 USD by 39.3 % of the sample population. Then, 29.4 % would like to pay a value between 1.00 USD to 1.25 USD, 20.1 % opt for a value of 0.50 USD to 0.75 USD, and only 11.1 % of the population would choose to pay between 1.25 USD to 1.50 USD for the freeze-dried product (Figure 29).

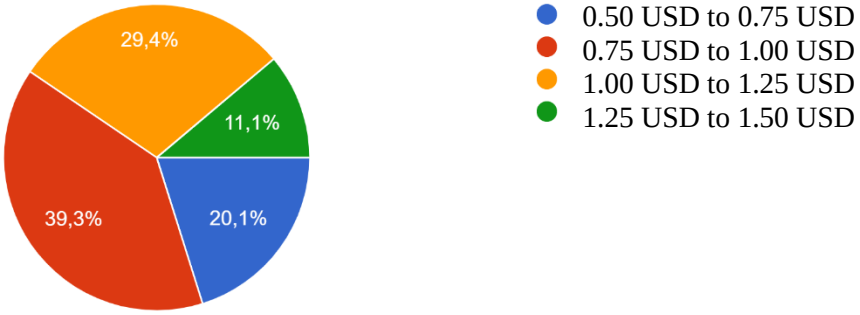


Figure 29. Prices chosen for a lyophilized product of 18 g of content.

Besides, the appropriate place for the sale of the lyophilized product was identified. The highest acceptance, 62.6 %, was supermarkets, although with a similar acceptance, 60.4 %, are the stores. Then, the minimarkets have an acceptance of 46.9 %, the online store 19.7 %, specialized stores 13 %, and finally, there are pharmacies with an acceptance of 8.5 % of the sample population (Figure 30).

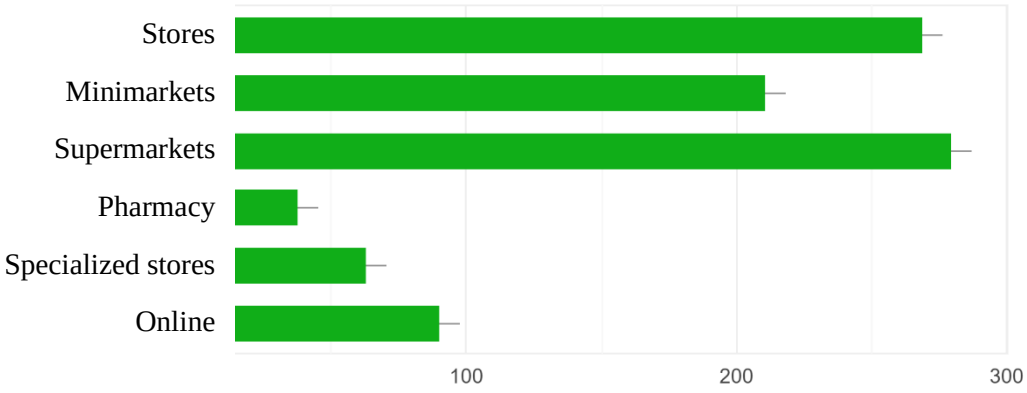


Figure 30. Acceptance of places for the sale of lyophilized products.

Then, the predisposition of customers to have advice during purchase and post-purchase was identified. 70.6 % of them would accept this advice, 19.9 % were undecided, and only 9.5 % would not accept this customer service. With these data, we proceeded to determine the type of assistance the population would like to have. The highest acceptance, 41 %, was for advice

by like-minded people in communities on the main social networks. Then, the web assistance had an acceptance of 31.3 %, the personal assistance with 29.4 %, the call center with 13.3 %, and finally, the options none had an acceptance of 14 % of the sample population (Figure 31).

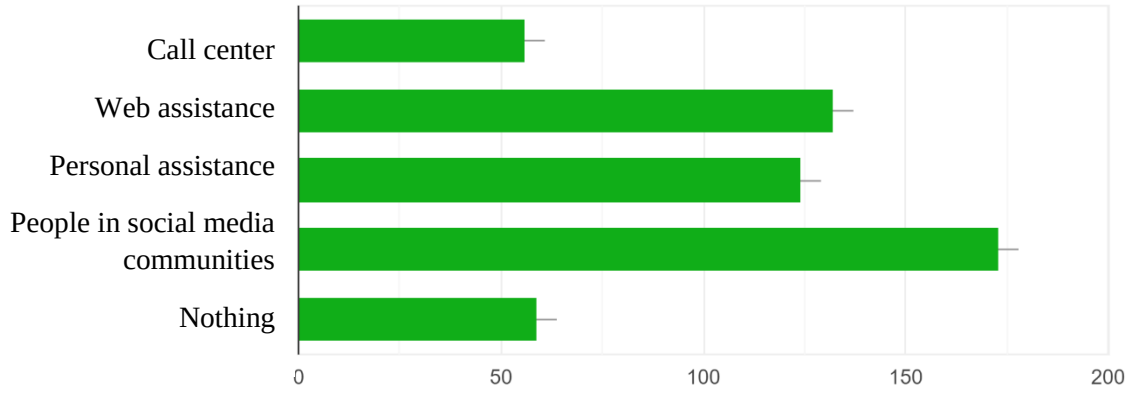


Figure 31. Type of customer service adopted by the market segment.

Finally, the primary sources of advertising that the client would accept were identified. Initially, there is Facebook with an acceptance of 63.7 %, followed closely by Instagram with an acceptance of 54 %. Then, Google had an acceptance of 34.1 %, YouTube of 30.1 %, and Tik-Tok with an acceptance of 16.4 % (Figure 32).

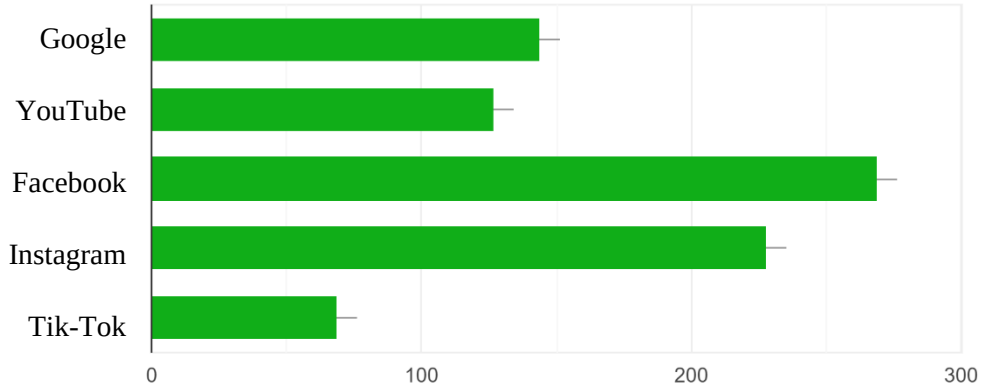


Figure 32. Advertising sources accepted by the market segment.

3.3. Chapter Remarks

The despite the crisis that Ecuador is going through due to the job decrease and the decrease in commercial activities due to COVID-19, it is possible to create a company in the food sector with the characteristics of this project. This is because there are mechanisms in the law that facilitate and promote the country's industrial development. Besides, it is necessary to add value to the vast strawberry production harvested in Cayambe, Otavalo, and Pedro Moncayo because its only source of sale is fresh products.

On the other hand, the market segment in this city accepts the proposal of a freeze-drying plant to process strawberry and offer it to the Quito market. The main stages for obtaining lyophilized food will be disinfection, classification, leaf removal, cutting, lyophilization, and packaging.

The market segment that the company will handle is divided into a market niche corresponding to the sale of assets: freeze-dried vacuum strawberry. On the other hand, rental of classification process service for farmers.

Therefore, the implementation of the Canvas business model is the simplest and most effective way to develop an innovative business model with a high impact on society. The implementation of the Business Canvas is carrying out in the next stage.

Finally, the viability of the project will be determined with the main evaluation methods of the project: present net value (NPV), internal rate of return (IRR), and cost-benefit ratio (B / C).

CHAPTER IV

4. STRATEGIC PROPOSAL

The information obtained in the previous chapter makes it possible to develop a Business Model Canvas proposal for a vacuum freeze-drying plant. Initially, we create the Business Canvas, where we make a detailed description of the internal and external aspects of the company (Figure 33). In this way, we simply summarize our business model. In turn, this makes it easy to identify errors or problems and correct them later.

Table 11 discribes the main components of the internal and external aspects of a company based in the Canvas methodology.

Table 11: Company aspects based in Canvas

Company Aspects	
Internal Aspects	**External Aspects**
Key alliances	Value proposal
Key activities	Relationship with customers
Key resources	Channels
Cost structure	Customer segmentation
	Sources of income

Figure 33. Business Model Canvas for freeze drying plant.

.

4.1. Market segments

The purpose of the company is to reach two types of market segments: market niche and farmer's association.

4.1.1. Niche Market

This market segment corresponding to the lyophilized products that the company is going to produce and was determined through a statistical market study where the variables considered were: total population size, economically active population with high SES, Age, and rate of people with healthy food trends (Table 12). As a result of these, 190,701 people are our potential clients. Besides, in the market research, the disposition to consume a new healthy food by this market segment of Quito city was vitrificated.

Table 12. Number of potential clients in Quito city.

City	**Quito**
Total population	2,781,641
High SES (%)	69.11
Subtotal 1	*1,922,392*
Age 20-39 years (%)	31
Subtotal 2	*595,942*
Healthy eating trends (%)	32
Subtotal 3	190,701
Potential customers	**190,701**

Source. (INEC, 2020).

According to Euromonitor International (2010), there is an increase in the demand for products without preservatives or additives, easy to buy, and low sugar and fat levels. This growth in nutritional needs and healthy eating leads many buyers to opt for processed products

that guarantee high nutritional quality. Therefore, the preference for healthy foods will also grow by at least 3.5 % annually (Segado, 2016).

4.1.2. Farmer´s Association

The industrial plant will only use the sorting machine one hour per day for freeze-drying food. This reason makes this machine available for the remaining 23 hours. Based on this, and the problem of the strawberries classification by farmers identified in the market research, the second market segment corresponds to the rental of services of classification processes. Initially, this service will be for three cantons, two in Pichincha and one in Imbabura. These cantons are highly agricultural; strawberry is one of the most cultivated products. According to the reports of the Development and Territorial Ordering Plan (PDOT, for its acronym in Spanish) of the cantons of Cayambe, Otavalo, and Pedro Moncayo, 18.2% of the population of Canton Otavalo work to agriculture. This percentage rises to 43.62% in the Cayambe canton. Finally, up to 55% of the population is dedicated to this work in the Pedro Moncayo canton. The company's purpose is to provide its services to this market segment too, and for these, the micro-location of the company will be these three cantons.

4.2. Value Proposal

According to the research market, the value propositions that our company will handle are the service of classification and vacuum freeze-dried products.

4.2.1. Vacuum Freeze Dried Food

The The most relevant value proposition that the company wants to handle is vacuum freeze-dried superfoods such as a healthy snack. The lyophilization dried food while preserving

its entire organoleptic and nutritional properties. In turn, this process increases the shelf life of the product for up to 24 months. Our freeze-dried foods will have the following characteristics:

- High nutritional integrity.
- Stable organoleptic properties.
- Low microbial activity due to the total elimination of the internal and surface water content in the food.
- No preservatives or additives.

Considering the market research results, Table 13 details the quantities of products the company wishes to produce during the 5 years.

Table 13. Number of lyophilized products per year.

Detail	Project horizon				
	Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Product	268,095	342,538	444,653	566,623	618,214
Quantity (kg)	4,825.71	6,165.68	8,037.56	10,199.22	11,127.86

Also, the vacuum freeze-drying process improves the operational flexibility of producers, reducing the risks of product perishing and facilitating its timely marketing according to demand. Finally, lyophilization is a method based mainly on cold and pressure reduction, which is why it is a reasonably stable process and does not alter our food's properties. This method guarantees an excellent quality of the product.

4.2.2. Service

The rental of the fruit's services classification is considered our value proposition for farmers' associations or independent, which will help them improve the quality and hygiene of their products for sale on fresh. Besides, it is intended to address the socio-economic problems

of the local agricultural sector due to the high human cost in production and the low surplus value obtained from the sale of fresh products. Also, it seeks to satisfy the technological need of local producers who wish to give added value to their products and extend their commercialization in national and international markets. Finally, an advantage of this service is that small and medium farmers can improve their economy during and after COVID-19 by producing and selling value-added products at a fair price.

4.3. Channels

According to market research, the company's marketing channels will be commercial team, social media, stores, mini markets, and supermarkets.

4.3.1. Commercial Team

The commercial team will be mainly in charge of establishing approaches with companies and associations of both suppliers and consumers, forming strategic alliances that reduce marketing costs and make efficient use of the company's resources. In the first place, the commercial team will be in charge of familiarizing the cantonal and parish GADS with the value proposition to identify and sign agreements with the principal agricultural associations in the areas of Cayambe, Otavalo, and Pedro Moncayo cities. On the other hand, the commercial team, taking advantage of the Organic Law for the Regulation and Control of Market Power and the Popular and Solidarity Economic Law, will sign agreements with the leading supermarket in Quito. It makes it easier for the ideal customer to access our value proposition in this city.

4.3.2. Social Media

The company will use social networks as an advertising medium to make our value proposition known to our ideal client and the public, freeze-dried superfoods. The four social

networks with significant acceptance have by the market segment will be used, which are: Facebook, Instagram, Google, and YouTube. Enterprise will use targeted paid advertising in the four platforms, considering a hierarchical range of platforms: Facebook, Instagram, Google, and YouTube.

4.3.3. Web Page

The website will be a direct method of marketing freeze-dried products and services. It is a method that will require more investment, but likewise, the profit margin per unit of product sold is much higher than an indirect method. This area will be in the hands of the marketing department and mainly focused on clients who have experience managing online purchases. Initially, it will benefit 19.7 % of the market research.

4.3.4. Stores, Minimarkets and Supermarket

Stores, Minimarkets and Supermarkets, are an indirect method of marketing our products. It is a method that requires less investment by the company. However, the profit margin per product sold is also much lower than direct marketing methods. With this method, we will facilitate the purchase of our product for customers who are not very familiar with online purchases representing 80.3 % of the market segment.

4.4. Relationships with Customers

Based on market research, the company, within the framework of providing the best customer service during and after-sales, will use four relationship mechanisms: Personal Assistance, Exclusive Personal Assistance, Automatic Services, and Communities.

4.4.1. Personal Assistance

This type of relationship will focus on personal contact with suppliers and direct customers. The company will establish a customer assistance department where communication will be through emails, assisted calls, and appointments to achieve this. One person will direct this area of the company, and the resources allocated will be minimal. This department will strengthen our trust with 29.4 % of the market segment and 100 % farmers. As a result, the company guarantees the well-being of the people.

4.4.2. Exclusive Personal Assistance

This type of relationship will be exclusively for supplier associations, private companies, and supermarket chains. A person from the customer service department will be designated for this task and will aim to establish a deep and intimate relationship with the customer for an extended period. With this, the company seeks to strengthen business partners that lead to achieving objectives with mutual benefit in the short, medium, and long term.

4.4.3. Automatic Service

The customer assistance area will designate a person in charge of managing the official website of the company. On this website, all our suppliers and clients will have the facility to create an account or profile to facilitate access to our products and services. Also, the company seeks to help 31.3 % of the market segment throughout the purchase and post-sale process and make their interaction with our company more pleasant.

4.4.4. Communities

This type of relationship with customers also is in the hands of the same person in charge of automatic services. The company will create a community on the main social networks such

as Facebook, Instagram, YouTube, and Tik Tok. By this means, 40 % of the market segment will have the possibility to interact with each other to exchange knowledge and solve problems mutually. This method allows the company to follow the line of knowing more about its market segment, identifying its problems, and solving them.

4.5. Key Resources

The key resources that the company needs to run its business model are physical and human.

4.5.1. Physical Resources

The physical resources constituted mainly made up of the assets of two sections of the lyophilization plant, the production and administrative area, are necessary for the installation and operation of the lyophilization plant.

The production area; the motor of the business model. The production area, which is the center of our business model. In this facility, it will be all the machinery and equipment necessary to carry out its products' processing. Also, we have the quality control department to guarantee the final quality of our product. The lists of all the machinery and equipment in the production area and the quality installation are in Table 14.

Table 14. Machinery and equipment in the production area.

Headings	Technical specifications	Quantity
Machinery and equipment	Freeze drying system	1
	Washing-disinfection system	1
	Classification system	1
	Stainless steel metal table	1
	Conveyor belt	1
	Metal drawer table	1
	Metal cutting table	1
	Tray table	1
	Industrial-scale	1
	Analytical balance	1
	Food packing machine	1
	Reverse osmosis equipment	1
	Reserve tank	1
	Utensils	1
	Plastic boxes	8
	Miscellaneous	1
	Laboratory equipment	1

On the other hand, the complement of the lyophilization plant is the administrative department, which will be in charge of legal, administrative, commercial documentation, and production reports. The items necessary for the optimal functioning of this are in Table 15.

Table 15. Administrative area resources.

Headings	Technical specifications	Quantity
Administrative	Computer	4
	Printers	4
	Telephone fax	1
	Cell phones	4
	Office desks	4
	Office filing cabinets	4
	Executive chairs	4
	Meeting table	1
	Blackboard	1
	Counter reception	1
	Meeting chairs	10
	Waiting room chairs	3
	General office waxes	5

4.5.2. Human Resources

The company's staff will be one of the key resources for the proper functioning of the business model. For this, it is essential to have highly qualified personnel both in the production area and in the administrative area that contributes to the growth of the company and the well-being of society. All the personnel required by the company to achieve these objectives are in Table 16.

Table 16. Company staff.

Area	Post	Quantity
Production	Production manager	1
	Operators	3
	Cleaning	1
	Logistics	1
Administrative	General manager	1
	Counter	1
	Secretary	1
	Marketing	1

The CEO is the person who will lead the company and will be responsible for the general meeting of partners. The main role that he will exercise is to make the appropriate decisions to fulfill the company's objectives. His delegates include an operations manager, an accountant, a secretary, and a marketer.

The operations manager will work in conjunction with the general manager to make adequate decisions at the operational level. This person will be in charge of managing and controlling the proper functioning of the operations inside the lyophilization plant. He is in charge of directing the 3 operators, a logistics person and a cleaner.

Diagram 2 represents an organizational structure of the company.

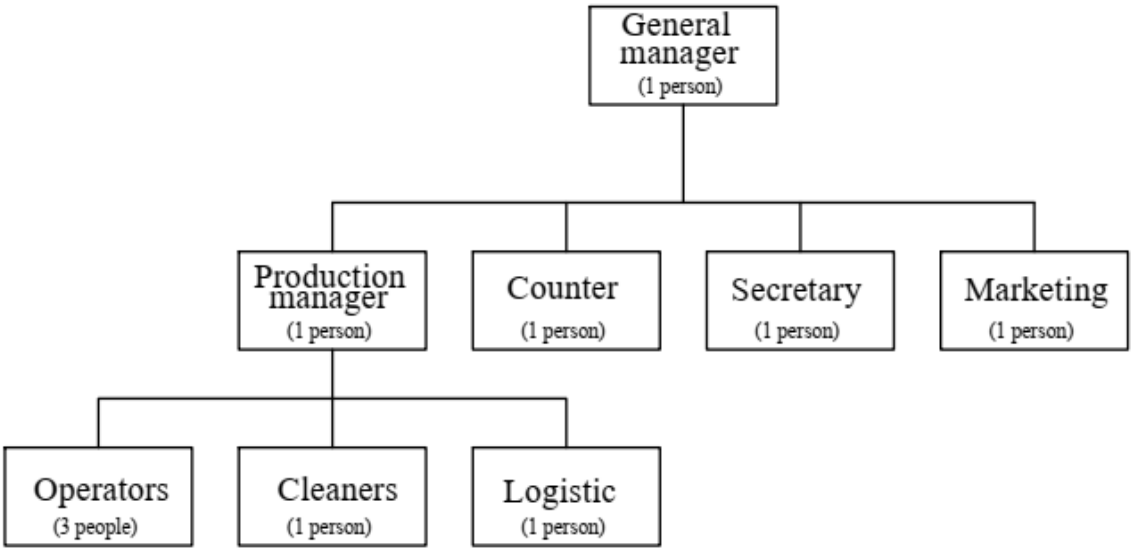


Diagram 2: Organizational structure of the company

4.6. Key Activities

The key activities that the company will carry out during its operation to maintain the business model are focused on the productive and commercial areas. The production area in charge of maintaining and improving the efficiency of the lyophilization process. Simultaneously, the commercial area will establish methods for adequately managing the company's sales and advertising platforms.

4.6.1. Optimization of Processes

According to Diagram 3, representing the general scheme of the lyophilization plant, one of the main key activities is the adequate control of lyophilization, maintaining optimal operating conditions throughout the process. It facilitates the identification of problems and their prompt response with a solution. This scheme also details all the activities and decisions that the workers take during food dehydration. This information facilitates the constant improvement of the logistics of the plant.

In turn, the process scheme contains the central axis to all processes of lyophilization. This main process is detailed in-depth in a block diagram, making it possible to more accurately identify the mass quantities of raw material and final product that the plant will handle (Diagram 4). This block diagram represents each fundamental stage of the lyophilization process and its respective mass balance for each of them.

The products of the plant will have quality standards ISO 9001, 22000, and INEN standard. It is essential to mention that safety standards established by OSHA are also taken into account. Besides, the following process of the fruit and food freeze-drying has been designed to achieve all of these quality norms.

a) Disinfection: At this stage the first (A), second (B), and third (C) quality fruit enters and is disinfected.
b) Classification: The matter (fruits or vegetables) is classified, the A quality continues the process, and the quality B and C are packing.
c) Leafless: At this stage, the sepal and pedicle of the fruit are removed.
d) Washing: The fruit or vegetables go through the spray machines and later to a wind machine to partially dry.
e) Cutting: The strawberry is cut into slices, and then they are placed on the trays
f) Freeze drying: The trays are placed in the vacuum freeze-drying machine for 8 hours.
g) Packaging: The quality of the freeze-dried fruit is evaluated and subsequently vacuum packaging is carried out.

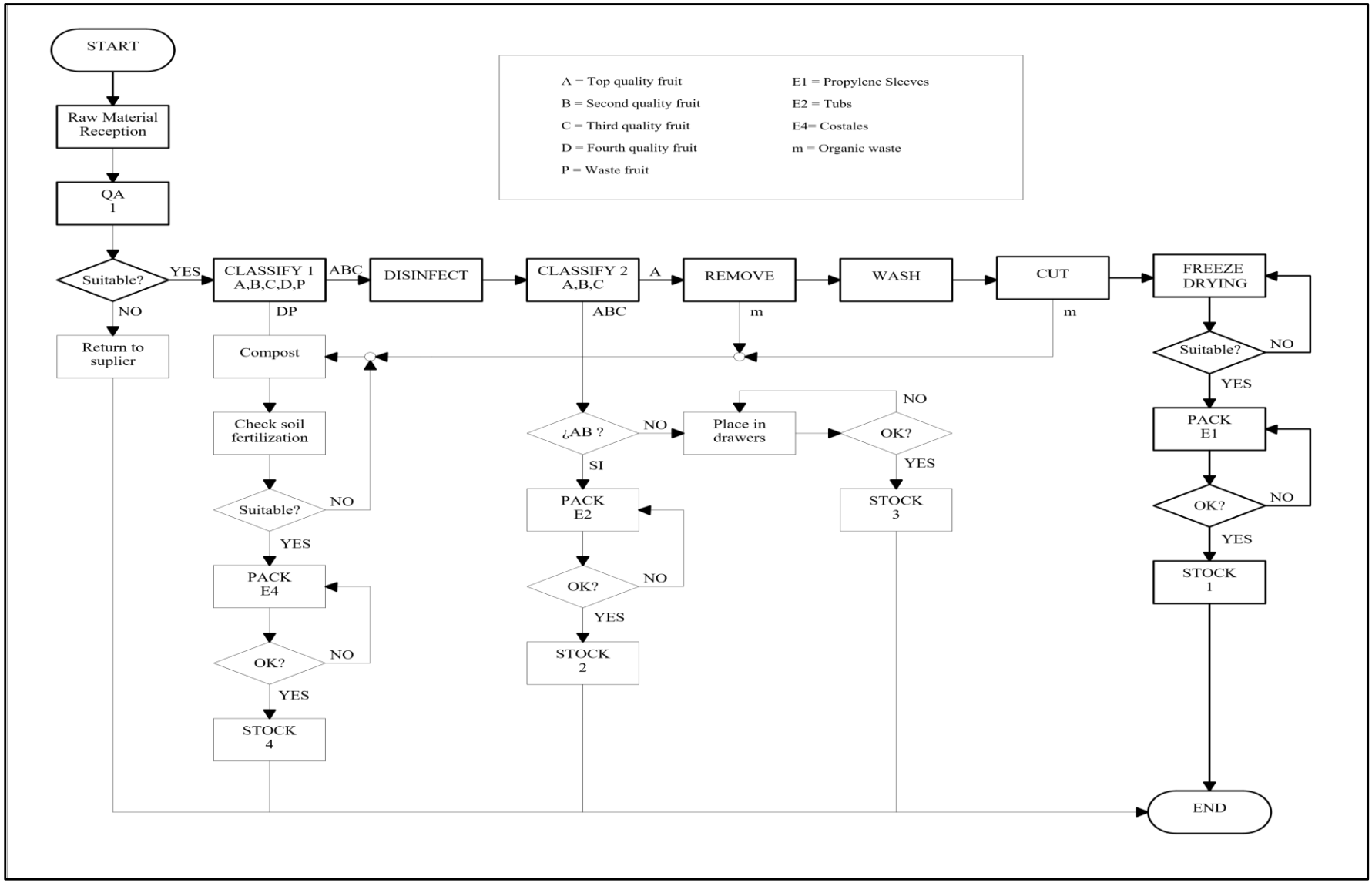


Diagram 3. Scheme of the vacuum freeze dryer plant.

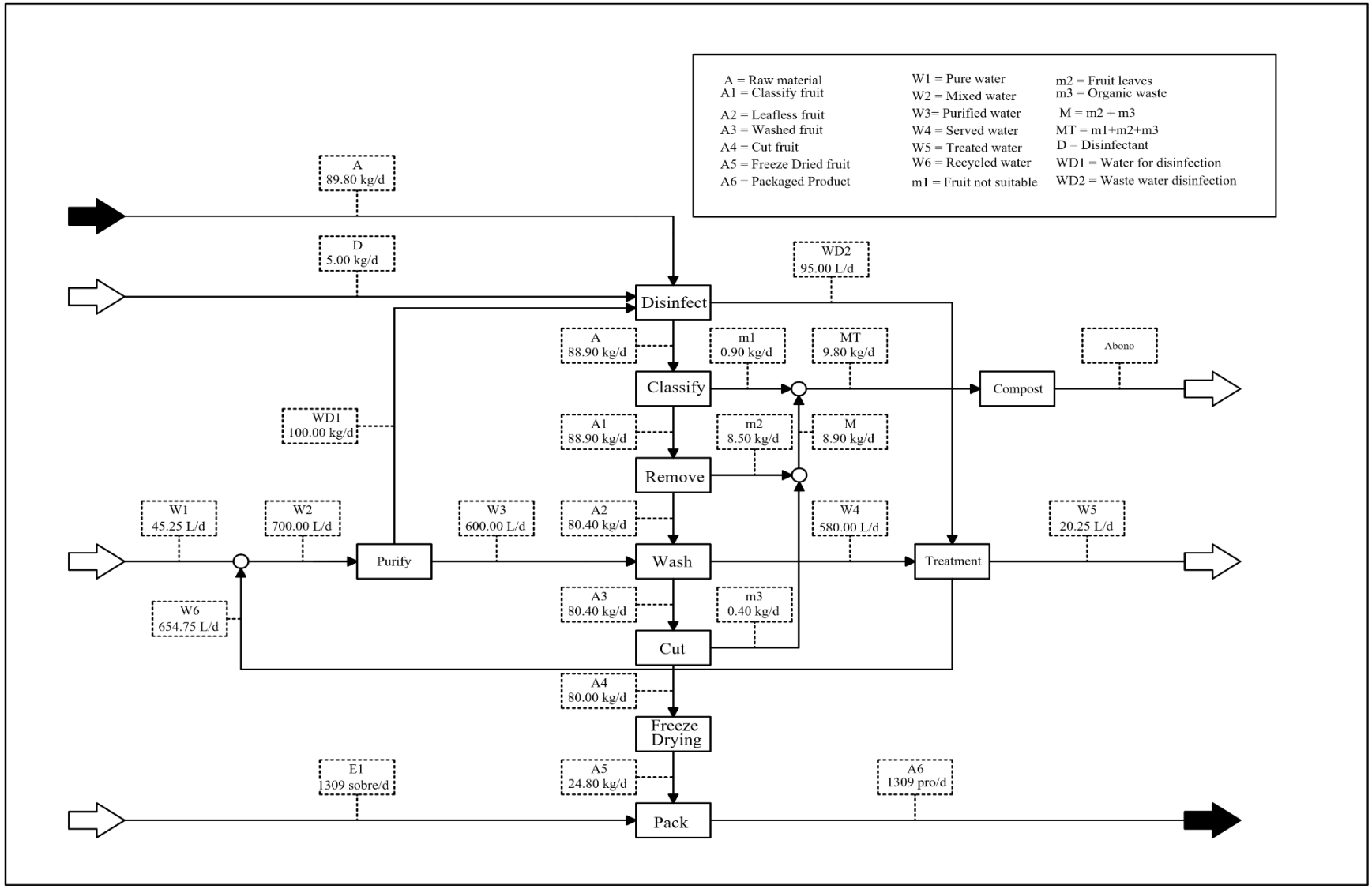


Diagram 4. Block diagram of vacuum freeze-drying plant.

4.6.2. Web Platform Administration

The administration of the web platform complements the key activities of the company. Through this platform, the corresponding service offers and the marketing of the final product will be made. Proper maintenance of the service and sales platform will improve the shopping experience of our customers. On the other hand, by improving the web service, we, in turn, increase the quality of our customer service.

4.7. Key Associations

The key associations that the company will feature are private companies and farmers associations.

4.7.1. Private Businesses

The strategic relationship that the company will adopt with private companies is type strategic alliances. It helps to find some common goals to improve our businesses. Based on the Law of Dominance of Market Power, agreements will be signed with the leading supermarkets in Quito; Supermaxi, Gran Aki, Mi Comisariato, and Santa María. As a result of this, we secure or guarantee the hangers for lyophilized product display. On the other hand, these companies will obtain great economic benefits by acting as an indirect channel of our business model.

4.7.2. Local Goverment

The company will have a strategic relationship with the local goverment of Cayambe, Otavalo, and Pedro Moncayo. It will benefit the company in identifying the different activities of farmers' associations in each of the selected cantons. Also, it helps to identify problems in the marketing chain of agricultural associations and help them with possible solutions. On the

other hand, the company and the GAD's will work together to achieve the strategic development objectives of promoting agricultural activities with sustainable and sustainable dynamics, with food security and sovereignty that each of these cantons. Also, allowing to promote and consolidate the development of the productive chains of the primary sector, respecting the principles of the popular and solidarity economy.

4.7.3. Farmers Associations

The strategic relationship that the company will adopt with the different farmers' associations is a customer-supplier type. With this key relationship, the company will guarantee the reliability of raw materials, also take advantage of the economy of scale to optimize resources and reduce direct costs. In turn, the company will guarantee farmers the non-intervention of intermediaries in the raw material marketing chain, thus ensuring standardization of the prices of their agricultural items.

4.8. Revenue Stream

This section has based on market research. The source of income that the company will obtain is through the sale of assets and a fee for use.

4.8.1. Sale of Assets

It is the primary source of income for the company. The main products that will be obtained in the freeze-drying plant will be dehydrated foods. Starting with the strawberry in the first year of development of the project. The base price of the product ex-factory was determined considering:

(a) Production costs

(b) Operating and administrative expenses

(c) Unit presentation of the product: packaging of 18 grams

(d) Increase in demand over time

(e) Economic projections for Ecuador (2020-2025)

(f) Project time: 5 years

(g) Net profit: zero (income equals expenses)

(h) Acceptance price by market segment to 18 gr of product

Table 17 shows the economic analysis results to establish the base price for 18 gr of product.

Table 17. Pricing for the value proposition: lyophilized product.

Detail	Project horizon				
	Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Base Price (USD) *	0.35	0.33	0.34	0.35	0.36

The financial study, present in chapter V, details the economic variables: NPV (Net present value) and IRR (internal rate of return), and B / C (Ratio/cost-benefit), which demonstrate the economic viability of the project.

4.8.2. Fee per Usage

The second source of income for the company is the usage fee corresponding to the rental of services. The following aspects are necessary to determine the price of the classification service:

(a) Direct and indirect costs

(b) Operating expenses

(e) Economic projections for Ecuador (2020-2025)

(f) Project time: 5 years

(g) Net profit: 20%

(h) Acceptance price by farmers

Table 18 shows the economic analysis results, which show the base price of the service per kilogram and per time of use for each unit operation.

Table 18. Value proposition price list: Classification service

Detail	Project horizon				
	Year 1	**Año2**	**Year 3**	**Año4**	**Year 5**
Price per weight (kg) USD	0.03	0.04	0.04	0.04	0.04
Price per time (h) USD	33.64	35.32	37.08	38.94	40.88

The financial study details the economic variables: NPV (Present Net Value) and IRR (internal rate of return), and B / C (Ratio/cost-benefit), which demonstrate the economic viability of the project.

4.9. Cost Structure

The company's costs during the installation and execution stages are Initial Investment, Fixed Costs, and Variable Costs.

4.9.1. Initial Investment

It is the highest and most important cost that the company will have. A large amount of this money will be to acquire land, construction of facilities, and purchase machinery, equipment, and implements.

In the first instance, the enterprise will buy the land and build the facilities (Table19). The location was determined using the method of qualification by points and the criterion of minimum costs, where different factors are considered, such as:

a) Climatic condition

b) Conveyance

c) Raw material availability

d) Labor availability

e) Access to consumption centers (Market)

Table 19. Infrastructure costs.

Detail	**Quantity**	**Unit price USD**	**Total USD**
Ground	1	20,000	20,000
Production facilities	1	20,000	20,000
Quality laboratory premises	1	6,000	6,000
Office premises	4	3,000	12,000
Sanitary	2	1,500	3,000
Enclosure	1	10,000	10,000
Parking lot	1	5,000	5,000
Guard booth	1	1,000	1,000
Local storage	1	10,000	10,000
Meeting room	1	3,000	3,000
Subtotal Infrastructure			**90,000**

Besides, the acquisition of machinery and production equipment and administrative real estate is initially required. The selection of said objects was made by evaluating each cauda's advantages and disadvantages.

Table 20 details the costs corresponding to each of the investment cost of the production instalations. The main things are the machinery, accessories for the treatment of water, and the quality control laboratory equipment. It is essential to mention that these values have already incorporated the 12% VAT and import taxes.

Table 20. Costs of machinery, equipment, and supplies of production instalations.

Area	Technical specifications	Quantity	Unit value USD	Total value USD
Production	Lyophilizer	1	95,000	95,000
	Classification system	1	14,000	14,000
	Washing system	1	22,000	22,000
	Stainless steel table	1	300	300
	Stainless steel drawer table	1	80	80
	Conveyor belt	1	2,000	2,000
	Stainless steel cutting table	1	300	300
	Stainless steel tray table	1	300	300
	Industrial-scale	1	70	70
	Analytical balance	1	300	300
	Food packing machine	1	1,800	1,800
	Reverse osmosis equipment	1	200	200
	Reserve tank 2000 L	1	800	800
	Utensils	1	150	150
	Plastic boxes	8	10	80
	Miscellaneous	1	2,500	2,500
	Laboratory equipment	1	6,000	6,000
Subtotal				**145,880.00**

Table 21 shows the costs corresponding to each of the investment cost of the administration area. The main thing is the computer - communication equipment and furniture. It is essential to mention that these values have already incorporated the 12% VAT and import taxes.

Table 21: Costs of machinery, equipment, and suppli-es of adminitration deparment

Area	Technical specifications	Quantity	Unit value USD	Total value USD
Administration	Computer	4	1,000	4,000
	Printers	4	150	600
	Telephone fax	1	200	200
	Cell phones	4	200	800
	Office desks	4	400	1,600
	Office filing cabinets	4	200	800
	Executive chairs	4	150	600
	Meeting table	1	1,000	1,000
	Blackboard	1	90	90
	Counter reception	1	500	500
	Meeting chairs	10	100	1,000
	Waiting room chairs	3	80	240
	Office waxes	5	272	1,360.25
Others	Incorporation procedures	1	6,000	6,000
Subtotal				**18,790.25**

4.9.2. Direct Cost

The company's direct costs are established for five years, which is the horizon of the project. Table 22 shows the direct costs corresponding to freeze-drying silver.

Table 22. Direct costs from the freeze-drying plant.

Detail	Project horizon				
	Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Land tax	100	122	146	171	194
Salaries	82,544.78	71,925.93	75,361.83	81,935.84	85,872.23
Raw material	5,139.38	6,288.99	8,198.31	10,403.20	11,350.42
Packaging (18g)	26,809.51	34,253.78	44,653.11	56,662.33	61,821.44
Boxes (36 envelopes)	1,191.53	1,522.39	1,984.58	2,518.33	2,747.62
Machinery insurance	1,420	1,420	1,420	1,420	1,420
Claims insurance	1,510	1,510	1,510	1,510	1,510
Machinery maintenance	800	800	1,000	1,000	1,000
Total (USD)	**119,515.21**	**117,843.10**	**134,273.83**	**155,620.71**	**165,915.71**

4.9.3. Indirect Cost

The indirect costs of the company are established for five years that is the horizon of the project. Table 23 shows direct costs for freeze-drying silver that are corresponding to water and electric energy.

Table 23. Indirect costs of the lyophilization plant.

Detail	Project horizon				
	Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Water	240.00	288.00	345.60	414.72	497.66
Electric energy	9,371.68	9,371.68	9,371.68	9,371.68	9,371.68
Total (USD)	**9,611.68**	**9,659.68**	**9,717.28**	**9,786.40**	**9,869.34**

CHAPTER V

5. ECONOMIC AND FINANCIAL ANALYSIS

5.1. Initial Investment

The investment to execute this stage of the project is 326,669.25 USD. This investment is for three strategic areas: Fixed Investments, Nominal Assets, and working capital (Table 24).

Table 24. Initial investment.

Heading	Investment USD
FIXED INVESTMENTS	
Facilities	90,000.00
Machinery and equipment	160,880.00
Furniture and items	7,189.25
Office equipment	5,600.00
Subtotal	**263,669.25**
NOMINAL ASSETS	
Constitution expenses	6,000.00
Pre-operational expenses	7,000.00
Subtotal	**13,000.00**
WORKING CAPITAL	
Cash	50,000.00
Subtotal	**50,000.00**
TOTAL (USD)	**326,669.25**

Money of fixed investments is to acquire land and construction of facilities and purchase machinery, equipment, articles, and office furniture. These values include import costs and taxes. On the other hand, nominal assets correspond to incorporation and pre-operational expenses. Finally, to ensure the cash flow from year cero of operation of the company, 15 % of the investment is allocated for working capital.

5.2. Financing

The financing required for the execution and start-up of the company has determined the amount of money necessary and the way to obtain it. Among the primary sources of financing is the contribution of partner 1, an association of agricultural producers, bank credit, and others (Table 25). Partner 1's contribution represents 8 % of the initial investment, and the most considerable contribution corresponds to the producers' association with 52 % of the total investment that internal. 24 % of the required investment will be obtained through a National Financier Corporation. Finally, 16 % of the investment will be through decentralized autonomous governments and the prefectures of the provinces of Pichincha and Imbabura.

Table 25. Financing sources.

Financing	
Detail	**Valor (USD)**
Partner 1	26,669.25
Farmers Association	170,000.00
Bank credit	80,000.00
Other sources of financing	50,000.00
TOTAL	**326,669.25**

5.3. Income Projections

Considering the proportion of acceptance of the market segment and farmers in market research. The projections of the company's income show an estimate of the money the company will make from the sale of assets and the rental of services. A dynamic statistical study was necessary to calculate the projection and Table 26 details the results obtained from the income projections. Also, it was crucial to consider the following variables:

(a) Project time

(b) Annual production

(c) Ex-factory price of products and services

(d) Increase in annual demand

Table 26. Income projection.

Detail	**Project horizon**				
	Year 1	**Año2**	**Year 3**	**Year 4**	**Year 5**
Services					
Classification USD	53,816.00	56,506.80	59,332.14	62,298.75	65,413.68
Sale of assets					
Snack USD	293,191.50	301,568.40	309,945.30	314,133.75	318,322.20

5.4. Expenses Projection

The projections of the expenses of the company show an estimate of the money that the company will allocate for the correct productive and administrative operation of the same. This projection was calculate using a dynamic statistical study and considering the following variables:

(a) Direct and indirect costs of production

(b) Operating and administrative expenses

(c) Equipment depreciation

(d) Bank charges

Table 27 details the results obtained from the projections of expenditures that the company will obtain due to the principal expenditures inputs during the project horizont. These expenditures are raw material, packaging and cartons.

Table 27. Expenses projection of expenditures inputs.

Detail	**Project horizon**				
	Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Expenditures Inputs					
Raw material	6,559.49	6,659.27	7,192.01	7,637.76	7,637.76
Packaging	34,217.5	36,270.55	3,9172.19	41,600.0	41,600.0
Cartons	1,520.78	1,612.02	1,740.99	1,848.89	1,848.89

Moreover, Table 28 complement details the results obtained from the projections of expenditures that the company will obtain due to the administration and operational expenses during the project horizont. The principal expenses of administration area are salaries, cost of telecommunications, internet, office supplies, income tax and credit bank. Complementing these expense is operational area that it has principal expenses like salaries, machinery and claims insurance, industries affiliation, depreciation and machinery maintenance.

Table 28: Expenses projection of operational and administrative areas

Detail	Project horizon				
	Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Operational and Administrative Expenses					
Territorial tax	100	122	146	171	194
Salaries	82,544.7	71,925.93	75,361.83	81,935.8	85,872.2
Basic services	9,611.68	9,659.68	9,717.28	9786.40	9,869.34
Conventional telephone	240.00	240.00	240.00	240.00	240.00
Cell phone/Internet	804.00	804.00	804.00	804.00	804.00
Grooming and cleaning	480.00	504.00	529.20	555.66	583.44
Office supplies	240.00	252.00	264.60	277.83	291.72
Machinery insurance	1,420.00	1,420.00	1,420.00	1,420.00	1,420.00
Claims insurance	1,510.00	1,510.00	1,510.00	1,510.00	1,510.00
Machinery maintenance	800.00	880.00	968.00	1,064.80	1,171.28
Industries affiliation	150.00	150.00	150.00	150.00	150.00
Banking expenses	80.00	80.00	80.00	80.00	80.00
Credit amortization	24,161.2	26,585.58	29,253.15	0.00	0.00
Credit interest	6,635.25	4,210.94	1,543.38	0.00	0.00
Income tax	37,594.8	44,763.56	49,860.60	54,927.0	54,349.3
Depression	7,291.28	7,291.28	7,291.28	0.00	0.00

5.5. Cash Flow

The cash flow determines the net values use the quantities of money estimated income and expenses during the five years of the project execution period. In this stance, values of incomes and expenses are considered of sources about operational and non-operational activity in the enterprise.

Table 29. Cash flow.

DETAIL	PROJECT HORIZON					
	Preop	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
INCOME						
Operational						
Freeze-Dried Product		293,192	301,568	309,945	314,134	318,322
Services		53,816	56,506	59,332	62,298	65,413
Working capital	50,000	0.00	0.00	0.00	0.00	0.00
TOTAL INCOME	**50,000**	**347,007**	**358,075**	**369,277**	**376,432**	**383,735**
EXPENSES						
Operational						
Payment to suppliers		42,298	44,542	48,105	51,086	51,086
Basic services		10,655	10,703	10,761	10,830	10,913
Direct labor		46,763	34,435	36,077	38,883	40,747
Administration salaries		35,781	37,490	39,284	43,052	45,124
Selling expenses		12,785	13,424	14,767	16,243	17,868
Machinery and equipment		3,730	3,810	3,898	3,994	4,101
Depression		7,291	7,291	7,291	0.00	0.00
Non-Operational						
Credit payment		30,796	30,796	30,796	0.00	0.00
Income tax payment		37,594	44,763	49,860	54,927	54,349
Office expense		720	756	793	833	875
Administration expenses		150	150	150	150	150
TOTAL	**0.00**	**239,812**	**235,435**	**242,650**	**215,497**	**221,733**
NET CASH FLOW	**-326,669**	**107,195**	**122,639**	**126,626**	**160,934**	**162,001**

5.6. NPV, IRR AND B/C Analysis

A study of economic feasibility was considering to determine the profitability of the project over time and subsequently when calculating the NPV, IRR, and B / C. The results of these economic indicators are in Table 30.

Table 30. Economic indicators: NPV, IRR, B / C.

NPV	**229,631 USD**
IRR	**27.92%**
B/C	**1.18**

5.7. Recovery Period

The recovery period for the initial investment was calculated from the cash flow and the corresponding balances (Table 31). The estimate corresponds to the period where the ending balance reaches absolute zero. That is the time where the accumulated net profit becomes equal to the initial investment of the project.

Table 31. Projection of balances.

Net Cash Flow	**-326,669**	**107,195**	**122,639**	**126,626**	**160,934**	**162,001**
Initial balance	**0**	**-326,669**	**-219,474**	**-96,834**	**29,792**	**190,727**
Final balance	**-326,669**	**-219,474**	**-96,834**	**29,792**	**190,727**	**352,729**

When carrying out the corresponding calculations and considering the estimated conditions in the cash flow calculation. As a result of this, the investment in this project will return in three years and ten months.

CHAPTER VI

6. CONCLUSIONS AND RECOMMENDATIONS

6.1. Conclusions

- The implementation of Business Model Canvas for the lyophilization plant has facilitated identifying internal and external factors that the company must handle suitably for its correct operation and permanence over time.
- The Canvas methodology has facilitated the modeling of the value proposition and the identification of the market segment. With this, the company will fulfill its objective of helping both the population of farmers and the people in our market segment by renting services and offering freeze-dried products.
- To meet the demand for lyophilized products in Quito city, the lyophilization plant will process a raw material of 83.50 kg per day. It will obtain a final production of 1,304 sachets of lyophilized product.
- Based on the financial study, the values of NPV of 229,631 an IRR of 27.92 %, and a cost-benefit ratio of 1.18 show the viability of the vacuum freeze-dried plant project.
- The time it will take to recover the money invested in the project is three years and ten months.

6.2. Recommendations

- To make a technical, technological, and economic study on the organic waste processing area and the water treatment area of the lyophilization plant.
- To prepare a detailed business plan based on the information obtained in this investigation.
- To Carry out a more detailed market study on the market niche and the number of potential customers.
- To elaborate an environmental study to establish the impact this business model may cause in the area.
- To Develop an organizational structure of the company to establish the duties and obligations of each of the factory employees.
- To Establish international alliances with exporting companies worldwide to internationalize the lyophilized product and increase its income.

REFERENCES

Bacaoanu, A., & Picos, M. S. (2005). Lyophilization-freeze-drying. I Basic principals. *Revue Roumaine de Chimie*, 433-443.

Teagarden, D. L., Wei, W., & Baker, D. S. (2010). Practical Aspects of Freeze-Drying of Pharmaceutical and Biological Products Using Nonaqueous Cosolvent Systems. En L. Rey, *Freeze-Drying/Lyophilization of Pharmaceutical and Biological Products* (págs. 254-287). Boca Raton: CRC Press.

Ahmed, J., & Rahman, M. (2012). *Handbook of Food Process Design.* Hoboken: John Wiley & Sons Editorial.

Atkins , P., & Jones, L. (2007). *Chemical Principles - The Quest for Insight.* New York: W. H. Freeman.

Banco Central del Ecuador. (2020). *CUENTAS NACIONALES TRIMESTRALES DEL ECUADOR: RESULTADOS DE LAS VARIABLES MACROECONÓMICAS, 2020.III.* Banco Central del Ecuador.

Banco Central del Ecuador. (2020). *Previsiones Macroeconomicas 2020-2021*. Banco Central del Ecuador.

Banco Mundial. (2021). *Perspectivas Economicas Mundiales.* Banco Mundial.

Barbosa, G., & Vega, H. (2000). *Food dehydration.* Zaragoza: Acribia SA.

Benavente, L., & Garcia, J. (1999). *Agri-food industries.* Valencia: Reproval.

Blank, S. (2013). “Why the Lean Start-Up Changes Everything”. *Harvard Business Review*.

Bradford , J., Ross, S. A., & Westerfield, R. (1996). *Fundaments.* Mexico DF: McGraw Hill.

Brennan, J. G., & Grandison, A. S. (2011). *Food Processing Handbook, Second Edition.* Weinheim: Wiley-VCH Verlag GmbH & Co. KGaA.

Cardona , D., & Forero, J. (2012). *Economic evaluation of plant redistribution projects.* Cali: Universidad Icesi.

Chaguay, L., Flores, J., Bayas, T., & Zapata, R. (2019). The business model: canvas methodology as a strategic innovation for the design of business projects. *Journal of Science and Research*, 87-99.

Cuper, O. (1965). *Artificial Dehydration – Food Freeze Drying.* México DF: CONADE.

D., F. (2015). El modelo Canvas en la formulación de proyectos. *Cooperativismo y Desarrollo*, 69-80.

Dirección General de Aviación Cicvil. (2020). *Dirección General de Aviación Cicvil*. Obtenido de https://www.aviacioncivil.gob.ec/la-operatividad-de-21-aeropuertos-del-ecuador-se-mantiene-durante-la-pandemia/?utm_source=rss&utm_medium=rss&utm_campaign=la-operatividad-de-21-aeropuertos-del-ecuador-se-mantiene-durante-la-pandemia

Fellows, P. J. (2009). *Food Processing Technology: Principles and Practice.* Cambridge: Woodhead Publishing.

Ferreira, D. (2015). *The Canvas model in project formulation.*

Financial Advisory. (2019). *Reporte Global de Competitividad 2019.*

Franks, F. (1986). Metastable water at subzero temperatures. *Journal of Microscopy*, 243-249.

Gaidhani, K. A., Harwalkar, M., Bhambere, D., & Nirgude, P. S. (2015). LYOPHILIZATION / FREEZE DRYING – A REVIEW. *World Journal of Pharmaceutical Research* , 516-543.

Geankoplis, C. J. (1999). *Transport processes and unit operations.* Mexico DF: CECSA.

Götze, U., Northcott, D., & Schuster, P. (2008). *Investment Appraisal: Methods and Models.* Berlin: Springer.

INEC. (2020). *Indice de Precios al Consumidor: Diciembre 2020.*

Jennings, T. A. (1999). *Lyophilization : Introduction and basic principles.* Englewood: Interpharm Press.

Jose Aguado, J. A. (2002). *Ingenieria de la Industria Alimentaria.* Madrid: Sintesis.

Karelovic, F. I. (2012). *Influence of the freezing method on the microstructural damage of lyophilized blueberries.* Repositorio uchille.

Kim, C., Mauborgne, R., & Adriana , D. (2005). *The Blue Ocean Strategy: How to Develop a New Market Where Competition Doesn't Matter.* Bogota: Grupo Editorial Norma.

Levine, H., & Slade, L. (1986). A polymer physico-chemical approach to the study of commercial starch hydrolysis products (SHPs). *Elsevier*, 213-244.

Luis Lozano, J. C. (2019). EL MODELO DE NEGOCIO: METODOLOGÍA CANVAS COMO INNOVACIÓN ESTRATÉGICA PARA EL DISEÑO DE PROYECTOS EMPRESARIALES. *Journal of Science and Research*, 87-99.

Martinez, R., & Prada, O. (2008). *Design and construction of a pilot lyophilizer for the study of dehydration and preservation processes of agro-industrial products by vacuum drying.* Bucaramanga: University of Santander.

Ministerio de Transporte y Obras Publicas del Ecuador. (2021). *Estado de la Red Vial Estatal: Abril 2021*.

Mumenthaler, M., & Leuenberger, H. (1991). *Atmospheric spray-freezedrying: a suitable alternative in freeze-drying technology*. 97-110.: International Journal of Pharmaceutics.

Nielsen. (2016). FMCG and Retail insights reports. Obtenido de https://nielseniq.com/global/es/insights/

Osterwalder, A., & Pigneur, Y. (2010). *Business model generation: a handbook for visionaries, game changers, and challengers.* Hobeken: John Wiley & Sons.

Otero , L., Martino, M., Zaritzky, N., Solas, M., & Sanz, P. (2000). Preservation of microstructure in peach and mango during high-pressure-shift freezing. *Journal of Fodd Science*, 466-470.

Rojas, M. D. (2015). *Evaluación de proyectos para ingenieros.* Medellin: ECOE.

Roos, Y. H. (1987). Effect of moisture on the thermal behavior of strawberries studied using differential scanning calorimetry. *Journal of Food Science*, 146-149.

Stephen Ross, R. W. (2003). *Fundamentals of Corporate Finance.* Nueva York: Mc Graw Hill.

Varela , A., & Zapata, M. (2015). *Business model for Urbana Bikes* . Medellin: EAFIT University.

White, G., & Cakebread, S. (1966). The glassy state in certain sugar-containing food products. *International Journal of Food Science & Technology*, 73-82.

APPENDIX A

COMPLEMENT RESULTS OF ECONOMIC STUDY

Appendix A.1: Workers salary to first year.

Company Personnel								
Worker	**N°**	**Monthly**						**Annual USD**
		Subtotal	**XIII**	**XIV**	**Holiday**	**Employer contribution**	**Total**	
Production manager	1	800	66.67	33.42	33.33	69.57	1,002.98	12,035.78
Operators	3	450	37.50	33.42	18.75	39.13	1,736.39	20,836.70
Cleaning	1	450	37.50	33.42	18.75	39.13	578.80	6,945.57
Logistics	1	450	37.50	33.42	18.75	39.13	578.80	6,945.57
General manager	1	1,000	83.33	33.42	41.67	86.96	1,245.37	14,944.48
Counter	1	450	37.50	33.42	18.75	39.13	578.80	6,945.57
Secretary	1	450	37.50	33.42	18.75	39.13	578.80	6,945.57
Seller	1	450	37.50	33.42	18.75	39.13	578.80	6,945.57
SUBTOTAL	10	4,500.00	375.00	267.33	187.50	391.30	6,878.73	82,544.78

Appendix A.2: Price and percentage of raw material.

Raw material	**Porcentage**	**Price KG USD**	**Price USD**				
			Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Fruit 1	0.4	1.2	3,695.49	3,133.78	3,384.48	3,594.24	3,594.24
Fruit 2	0.2	0.9	1,108.65	1,175.17	1,269.18	1,347.84	1,347.84
Fruit 3	0.1	1.1	677.51	718.16	775.61	823.68	823.68
Vegetable 1	0.1	0.5	153.98	326.43	352.55	374.40	374.40
Vegetable 2	0.2	1	923.87	1,305.74	1,410.20	1,497.60	1,497.60
TOTAL	1		6,559.49	6,659.27	7,192.01	7,637.76	7,637.76

Appendix A.3: Direct monthly expenses.

Monthly Administration Fee for the First Year				
Headings	**Technical specifications**	**Monthly amount**	**Unit Value USD**	**Total Value USD**
Personal	General manager	**1**	1,245.37	1,245.37
	Accounting Engineer	1	578.80	578.80
	Marketing	1	578.80	578.80
	Secretary	1	578.80	578.80
	Cleaning	1	578.80	578.80
Taxes	Territorial Tax	1	8.33	8.33
Services	Landline	1	20	20.00
	Cell phone	1	32	32.00
	Internet	1	35	35.00
	Membership Fee	1	12.5	12.50
	Banking expenses	1	6.67	6.67
	Credit amortization	1	529.83	529.83
	Credit Interest	1	552.94	552.94
	Income tax	1	3,152.35	3,152.35
Supplies	Grooming and Cleaning Supplies	1	40.00	40.00
	Office supplies	1	20.00	20.00
TOTAL				**6,724.81**

Appendix A.4: Selling monthly expenses.

Monthly selling expenses for the first year				
Headings	**Technical specifications**	**Monthly amount**	**Unit Value USD**	**Total Value USD**
Advertising	Social media	1	43.75	43.75
	Google	1	8.75	8.75
	Web page	1	13.13	13.13
	Posters and Flyers	1000	0.03	30.00
Transport	Transport	5	200	1,000
Supplies	Rent at Fairs	1	8.75	8.75
TOTAL				1,104.38

Appendix A.5: The operational and economic equilibrium point of the company

Detail	**Project horizon**				
	Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Production (Units)	342,175	362,706	391,722	416,000	416,000
Total fixed cost	128,672.56	120,319.78	127,543.03	137,123.50	141,082.89
Total variable cost	9,611.68	9,659.68	9,717.28	9,786.40	9,869.34
Total fixed expenses	35,781.17	37,490.03	39,284.33	43,052.37	45,124.79
Total indirect expenses	1,050.00	1,102.50	1,212.75	1,334.03	1,467.43
Variable Cost / Unit	0.03	0.03	0.02	0.02	0.02
Total unit cost	0.40	0.36	0.35	0.35	0.36
Factory unit price	0.8	0.8	0.8	0.8	0.8
Balance Point Production	**160,841**	**150,400**	**159,429**	**171,405**	**176,354**
Monetary Equilibrium Point	**128,672.53**	**120,319.76**	**127,543.01**	**137,123.48**	**141,082.87**

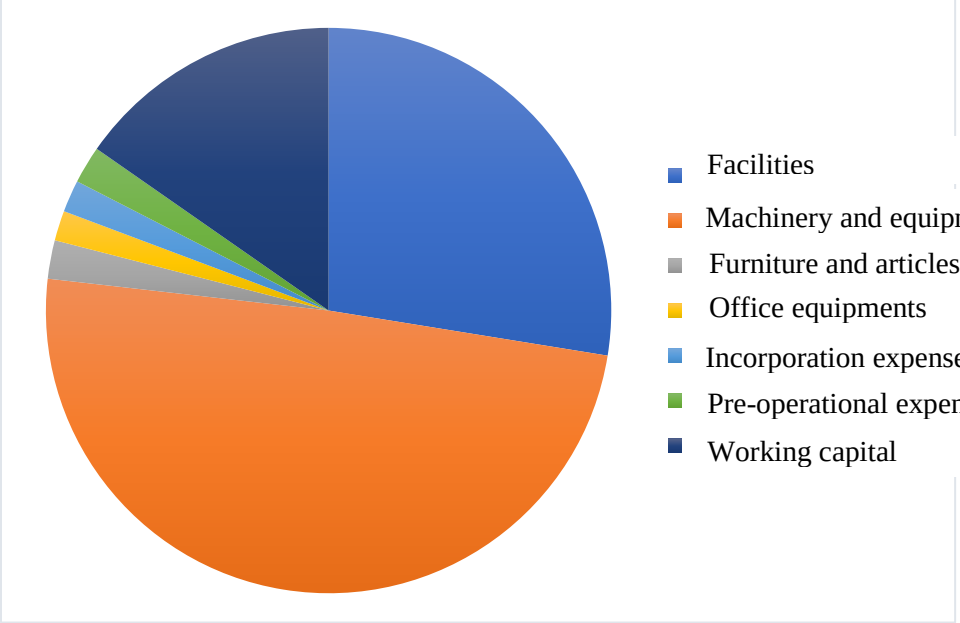
Appendix A.6: Depreciation of machinery, equipment, and objects

Detail	No.	Object value USD	Total object value USD	Salvage value USD	Depreciation		
					Year 1	Year 2	Year 3
Freeze Drying system	1	95,000	95,000	19,000	63,33.33	63,33.33	63,33.33
Classification system	1	24,000	24,000	4,800	1,600.00	1,600.00	6,333.33
Washing system	1	16,000	16,000	3,200	1,066.67	1,066.67	1,066.67
Disinfection system	1	12,000	12,000	2,400	800.00	800.00	800.00
Stainless steel metal table	1	300	300	60	20.00	20.00	20.00
Conveyor belt with spray	1	2,000	2,000	400	133.33	133.33	133.33
Metal cutting table	1	300	300	60	20.00	20.00	20.00
Bandera table	1	300	300	60	20.00	20.00	20.00
Industrial-scale	1	70	70	14	4.67	4.67	4.67
Analytical balance	1	300	300	60	20.00	20.00	20.00
Food packing machine	1	1,800	1,800	360	120.00	120.00	120.00
Reverse osmosis equipment	1	200	200	40	13.33	13.33	13.33
Reserve tank	1	800	800	160	53.33	53.33	53.33
Laboratory equipment	1	1,700	1,700	340	113.33	113.33	113.33
Furniture and articles	1	7,189.23	7,189.23	14,37.84	479.28	479.28	479.28
Computing team	1	4600	4600	920	306.67	306.67	306.67
Office equipment	1	1,000	1,000	200	66.67	66.67	66.67
Facilities and terrain	1	90000	90000	90000	-5000.00	-5000.00	-5000.00
TOTAL (USD)		**260,299**	**260,369**	**124,074**	**6,357.95**	**6,357.95**	**6,357.95**

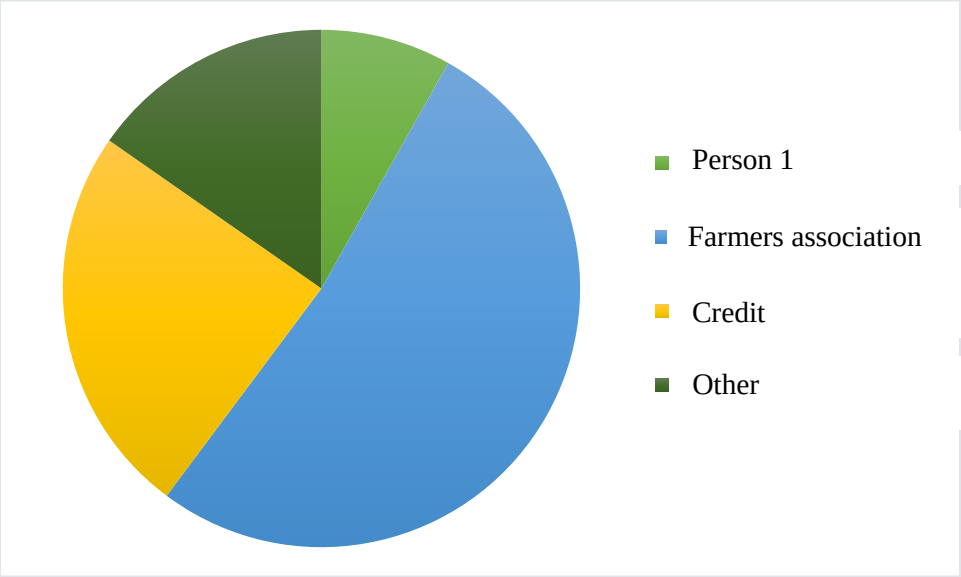
Appendix A.7: Credit amortization

Amortization Table with Fixed Fee					
Amount	80,000.00				
Term / Months	36				
Annual interest	10				
Month Interest	0.008				
Monthly fee	2,566.38				
Year	**Initial**	**Fixed Fee**	**Interest**	**Capital**	**Final**
0					80,000.00
1	57,941.57	2,566.38	463.53	2,102.84	55,838.73
2	31,566.99	2,566.38	252.54	2,313.84	29,253.15
3	2,546.01	2,566.38	20.37	2,546.01	0.00
	TOTAL	**92,389.58**	**12,389.58**	**80,000.00**	

Appendix A.8: Pie chart of the total investment amount



Appendix A.9: Funding sources pie chart



APPENDIX B

SURVEYS MODELS

Appendix B.1: Questionnaire of **s**urvey to farmers

Survey of Strawberry Agricultural Producers Located in the Cantons of Cayambe, Otavalo and Pedro Moncayo

Objective: Determine the marketing system for strawberries produced by farmers located in the cantons of Pedro Moncayo, Cayambe and Otavalo

Farmer's Name:

Place:

Date:

1) What is the amount of land used for your current strawberry crop?
2) What is the average amount of monthly strawberry production you produce per month?
3) What is your way of marketing your agricultural product: Direct sale, Intermediary, companies, supermarket, export, other?
4) What packaging do you use to sell your fresh agricultural product: bags, baskets, drawers, buckets, others?
5) What is the average price for 12 kilograms?
   Special Quality:
   First Quality:
   Second Quality:
   Third Quality:
6) Do you consider the average price is fair (12 kg)? Yes/No? Why?
7) What would be the fair average price for you: +1.00 USD, +2.00 USD, +3.00 USD, +4.00 USD, other?
8) How often do strawberry prices change?
9) When the fresh agricultural product is sold, does the buyer come directly to buy the products on your farm? Yes/No?

10) Do you add value to your agricultural product (processed product)? Yes/No? Which one?

11) What packaging do you use for your value-added product?

12) How much, in grams, of the agricultural product does each package contain?

13) What is your way of marketing your processed product?

14) At the time of the mass sale of the processed product, does the buyer come directly to collect the products from his farm?

15) If the answer to question 9 is "No": What transport do you use to move your products for sale: truck, van, bus, car, heavy-duty transport?

16) Is the means of transportation: Own or rent?

17) Do you use any of the following processes after harvest and before sale to the consumer, company and / or intermediary: classification, washing, disinfection, storage, other?

18) In what hierarchical order do you use the processes mentioned above?

19) Are these processes carried out manually or using machinery?

20) What is the estimated time spent on each of these selected activities per worker?

21) What are the costs that you have: workers, purchase of packaging, maintenance, others?

22) How many workers do you employ?

23) What type of contract do you have with your employees: daily, weekly, monthly, annual, other?

24) According to the answer to question 27, What is the salary that you pay your workers?

25) If a company offers the service of classification, washing, disinfection and storage for its agricultural products, would you like to access these services? Yes/No? Why?

26) If your answer to question 25 was "Yes": Mention the services you would like to access.

27) If you answer "yes" to question 25: How much money would you pay to use this service for one kilogram of your product?

Appendix B.2: Questionnaire of survey to market segment in Quito

Survey to Know the Demand for Freeze Dried Food in the City of Quito

Objective: To know the opinion of the clients about the characteristics of a healthy product: freeze-dried food.

Age:

1) Do you eat dehydrated food to maintain a good diet? Yes/No? Why?
2) What dehydrated food do you consume most often?
3) How often do you eat dehydrated food?
4) What is the presentation that you usually buy: 10gr, 15gr, 20gr, 25gr, 50gr, another?
5) What is the place where you buy dehydrated fruits: Stores, Minimarkets, Supermarkets, Specialized stores, other?
6) Where do you consume these dried fruits: Home, School, Work, other?
7) In what period of the day do you usually consume these foods: Morning, Noon, Afternoon, Night?
8) Do you know about freeze-dried fruits? Yes / No?
9) Did you know that freeze-dried fruits preserve 99% of the nutrients and preserve the organoleptic properties of a food? Yes / No?
10) Did you know that freeze-dried foods have better nutritional and preservation properties than dehydrated foods? Yes / No?
11) Name three freeze-dried fruits you would like to taste in hierarchical order?
12) Knowing that freeze-dried foods guarantee the preservation of 99% of the nutrients of a food, they retain their shape, color and aroma, in addition, that you can keep it for up to 24 months, what price do you consider acceptable to pay for a Snack (18g) of freeze-dried fruit?
    a) 0.50 to 0.75
    b) 0.75 to 1.00

c) 1.00 to 1.25

d) 1.25 to 1.50

e) Other

13) Where would it be easier for you to buy this product: Stores, Minimarkets, Supermarkets, Specialized stores, Online, Pharmacies, another place?

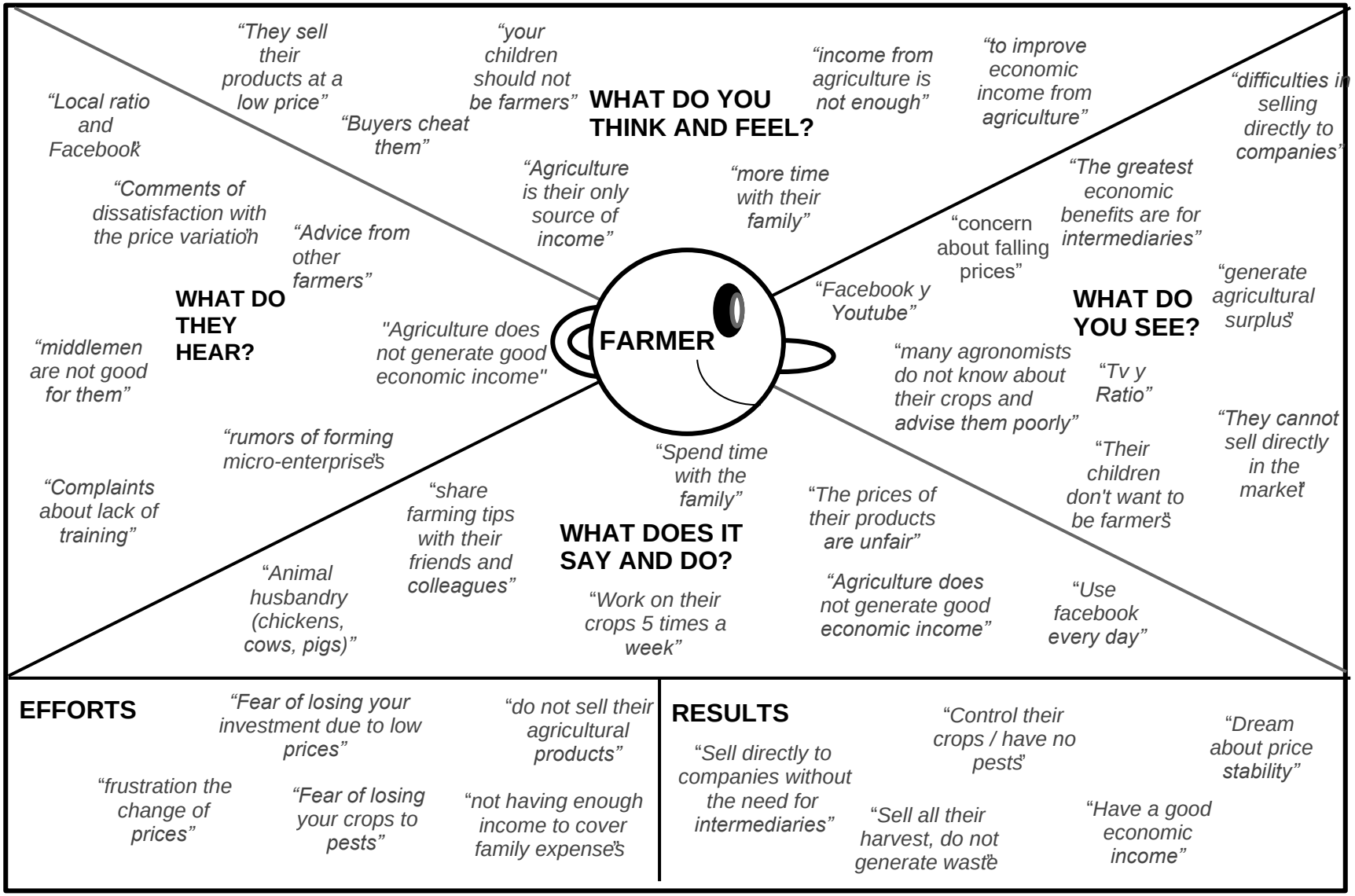
14) What would be the payment method that you would like to choose: Cash, Card, Transfer, other?

15) Would you like to have a person advise you during the purchase of a lyophilized product? Yes / No?

16) If answer 16 is "Yes": What type of customer support would you prefer to use: Call center, web support, personal support, community?

17) On which web platform or social network would you like to appreciate freeze-dried products: Google, YouTube, Facebook, Instagram, Tok-tok, other?

Appendix B.3: Farmer Empathy Map



Appendix B.4: Market Segment Empathy Map: Athletes