Journal of Engineering, Management and Information Technology

ASPUR PUBLISHING

Vol. 04, No. 02 (2026) 145-156, doi: doi:10.61552/JEMIT.2026.02.004 - http://jemit.aspur.rs

PROPOSAL FOR THE IMPLEMENTATION OF A CREAM-BASED ICE CREAM COMPANY FEATURING PERUVIAN CULTURALLY ROOTED FLAVORS: A TECHNICAL-ECONOMIC APPROACH

Carmen Villanueva[1]
Ayrton Fernando Sotomayor Figueroa
Diego Angel Liñan Salinas
Reymy Jorge Zeballos Liendo
Cristina del Rocío Tejada Barreda

Received 03.05.2025.
Revised 14.06.2025.
Accepted 18.07.2025.

Keywords:

Customized Ice Cream; Liquid Nitrogen; Innovation; Superfoods; Economic Feasibility.

Original research

A B S T R A C T

In the city of Arequipa the ice cream market is characterized by high standardization, offering largely homogeneous products that fail to fully satisfy consumer expectations. In response, this paper proposes a technical-economic alternative through the establishment of a company that produces cream-based ice creams using functional foods of Peruvian origin, presented in customized emoji shapes and prepared on-demand using liquid nitrogen freezing. This method ensures optimal freshness, a creamy texture, and a visually engaging consumer experience. The methodology adopted a mixed-methods approach, combining both qualitative and quantitative techniques. The proposed production line is structured into three key phases: base preparation, raw material processing, and final shaping and presentation. Through observational research and surveys conducted among individuals aged 20 to 35 in Arequipa, a high level of acceptance was identified, with particular emphasis on the product's innovative nature, health benefits, and emotional connection with consumers. A comprehensive financial analysis further demonstrated the project's strong profitability, reinforcing its economic feasibility. In conclusion, this proposal addresses an unmet market need, promotes the revaluation of native ingredients, and represents a sustainable and differentiated business model with the potential to drive regional economic development.

1. INTRODUCTION

Over the past decade, the ice cream market in Peru has experienced sustained growth, reflecting a transformation in consumer habits and an increasing appreciation for quality and innovation in food products (Popkin & Reardon, 2018). According to Leiva (2024), ice cream sales in Peru reached 788 million soles in 2022, with projections surpassing one billion soles by the end of 2024, representing a 32% increase. This growth is not only driven by higher overall demand, but also by a marked shift toward more conscious and health-oriented consumption. Consumers are increasingly seeking products made with natural ingredients, free from

[1] Corresponding author: Carmen Villanueva
Email: cvillanuevad@ucsp.edu.pe

artificial coloring, low in sugar, or gluten-free, favoring options that promote health and well-being (Barry-Ryan et al., 2020).

In this context, Peru holds a strategic advantage due to its vast biodiversity of fruits, seeds, and plants with high nutritional value—such as aguaje, tarwi, and cañihua (Casanave & Ruiz, 2022)—which can be integrated into innovative products like functional ice creams. This shift toward healthier foods has led to a 69% increase in this product category over the past five years, attracting new market entrants and fostering business models that aim to position themselves through authentic, nutritious, and forward-thinking offerings.

However, as highlighted by Moreno-Quispe et al. (2023), Marketing Manager of Nestlé's Ice Cream Division, per capita ice cream consumption in Peru remains relatively low—approximately 2 liters annually—compared to other South American countries such as Chile (8 liters) and Brazil (4 liters). This gap presents a significant expansion opportunity within the Peruvian market, particularly if differentiated, affordable products can be successfully positioned in alignment with current health-conscious and emotionally resonant consumer trends.

Moreover, the ice cream sector has demonstrated resilience in the face of inflation and economic slowdown, sustained by pricing strategies that accommodate diverse consumer segments. For instance, during the summer season, the average Peruvian consumes between two to three ice creams per week (Rodríguez, 2024).

Despite national progress, the ice cream industry in the city of Arequipa has not yet reached its full development potential. Local businesses tend to offer highly similar products, hindering customer loyalty. Innovation remains limited, both in terms of flavor development and service delivery. There is a notable absence of Andean ingredients with proven health benefits, and alternative consumer engagement strategies are rarely explored.

Within this framework, the present study seeks to add value through the analysis of personalized ice creams, investigating the implementation of efficient large-scale production while emphasizing the nutritional benefits of so-called Peruvian "superfoods" such as cañihua, tarwi, and hierbabuena. Multiple studies have assessed the nutritional profile of Andean grains such as quinoa, cañihua, kiwicha, and tarwi, indicating that the first three share comparable nutritional properties—with some variations: cañihua is higher in protein and fiber; kiwicha stands out for its unsaturated fat content; and quinoa contains a greater proportion of carbohydrates, making it suitable for individuals engaged in intense physical activity. Notably, tarwi, which is a legume rather than a grain, exhibits the most complete nutritional composition, offering a protein content of 44.3 g per 100 g—more than double that of cañihua—along with a considerable amount of healthy fats. Its low carbohydrate content also makes it an excellent option for individuals with diabetes or those aiming for weight management.

Therefore, the strategic incorporation of Andean ingredients into the food industry represents a valuable opportunity to promote healthier dietary patterns among the population. In this regard, the proposed business model focuses on establishing a company that produces and markets cream-based ice creams incorporating Peruvian superfoods such as aguaje, tarwi, cañihua, and other high-value nutritional ingredients (Gomez Cahuata et al., 2022). These ice creams will be presented in innovative and accessible formats, targeting young consumers aged 20 to 35 belonging to socioeconomic segments A and B, particularly in districts such as Cayma and Yanahuara, where there is a growing interest in conscious and healthy consumption habits.

This proposal seeks not only to differentiate itself through the nutritional and cultural value of its ingredients, but also to foster an emotional connection with customers through product personalization—offering a functional, appealing, and high-potential alternative within the local market.

Within this framework, the objective of this study is to evaluate the technical and economic feasibility of creating a company dedicated to the production and commercialization of cream-based ice creams made with Peruvian superfoods. The proposed business model aims to deliver an innovative and health-promoting product, while also encouraging the responsible use of native ingredients, advancing sustainability within the food industry, and contributing value to the local production chain through the revaluation of Peru's traditional crops (Barrett, 2024).

2. PRELIMINARY ANALYSIS

This research project was based on a quantitative methodology which, in pursuit of its general objective, applied statistical analyses using historical ice cream production data from the city of Arequipa, as well as the projected population growth reported by the Instituto Nacional de Estadística e Informática (INEI) (2024). Based on this secondary information, a projection of the local ice cream supply was developed, allowing for the estimation of unmet demand in the regional market for the periods between 2025 and 2030. These projections revealed a clear business opportunity to address this demand through the development of an innovative and customized business model within the artisanal ice cream sector.

This study was further complemented by the design of a personalized cream-based ice cream production process, structured into three clearly defined process units: preparation of the ice cream base, raw material processing, and finishing and presentation operations. The methodology adopted to ensure both efficiency and sustainability incorporated various qualitative elements, such as a detailed inventory of productive activities and the application of industrial engineering principles to determine spatial requirements using the Guerchet area method. This approach enabled not only the initial design of a new production facility, but also the optimization of resource usage—improving equipment layout, process

flow management, and working area ergonomics (Battini et al., 2011; Neumann et al., 2006).

Lastly, a comprehensive economic-financial analysis was carried out based on the calculation of key financial indicators such as Net Present Value (NPV), Internal Rate of Return (IRR), Payback Period (PBP), and Benefit-Cost Ratio (B/C). These metrics are essential for projecting the expected cash flows the enterprise might generate. They provided a robust perspective on the financial viability of the project, allowing for an accurate assessment of its profitability and sustainability in the medium term.

2.1 Nutritional Potential and Background

According to Kotler and Armstrong (2012), one of the key strategies for achieving competitive advantage is differentiation—precisely the strategy adopted by this ice cream venture. This differentiation goes beyond design and user experience, placing strong emphasis on the nutritional content and natural origin of the ingredients employed. Unlike conventional ice creams, our products are formulated with regional ingredients known for their functional properties—such as tarwi, aguaje, and spearmint—that offer tangible health benefits to consumers.

For example, aguaje is rich in vitamin A, vitamin C, and phytoestrogens, making it a powerful natural antioxidant. Tarwi is notable for its high protein and dietary fiber content, making it ideal for individuals following specialized diets or seeking to improve digestion. Spearmint, in turn, provides digestive, anti-inflammatory, and refreshing effects. Additionally, the ice creams are topped with functional ingredients such as chia seeds, popped quinoa, or kiwicha, further enhancing their nutritional value. Thus, the product not only differs in taste and presentation, but also actively promotes more conscious and health-focused eating habits, in alignment with current market trends.

While ice cream is widely appreciated for its enjoyable flavor and cooling properties, its nutritional value is generally minimal. Most traditional market offerings are high in fats and refined sugars, classifying them as indulgent items rather than meaningful sources of nutrition. This issue is clearly demonstrated in Table 1, which compiles nutritional data extracted from the labels of commercial brands available in the local market.

Table 1. Nutritional Values of Traditional Ice Creams

Nutritional values	Traditional ice cream	Yogurt ice cream
Energy Value (kcal)	326.7	200
Fat (g)	21.51	11
Saturated Fats (g)	12.91	9
Sugar (g)	22.67	24
Protein (g)	4.53	3

As shown in Table 1, traditional ice creams are characterized by their high sugar content (22.67 g) and fat content (21.51 g) per 100 grams, making them unsuitable for frequent consumption due to their adverse health effects. In contrast to these values, this project proposes the use of natural ingredients with functional properties—such as tarwi, aguaje, and spearmint—whose nutritional qualities significantly enhance the value of the final product. Table 2 presents the nutritional values of these three ingredients, highlighting their low saturated fat content and substantial protein contribution. This clearly demonstrates the nutritional gap between conventional ice creams and those developed with these superfoods.

Table 2. Nutritional Values of Tarwi, Aguaje, and Spearmint per 100 g

Nutritional values	Tarwi	Aguaje	Spearmint
Energy Value (kcal)	371.0	283.0	43.00
Fat (g)	16.5	25.0	
Carbohydrates (g)	23.0	18.10	
Sugar (g)	4.1	2.70	
Protein (g)	44.3	3.00	
Calcium (mg)	229	74.00	210
Iron (mg)	6.8	-	9.50
Water (g)	4.8	33.60	86.40
Phosphorus (mg)	390	27.00	75.00
Vitamin A		1062 mg	123 μg
Vitamin B			
Vitamin C (mg)		26	31

As can be observed, one of the most relevant aspects when comparing functional foods—or superfoods—with traditional ice cream flavors is the significant difference in fat content, which is substantially lower in the former. This reduction constitutes a major health benefit for the consumer. Furthermore, natural ingredients such as tarwi, aguaje, and spearmint not only contribute less fat but are also rich sources of essential minerals such as calcium, iron, and iodine. These nutrients play a key role in strengthening the immune system, supporting bone health, and ensuring the proper functioning of the human body. Therefore, the incorporation of these superfoods not only enhances the nutritional profile of the final product, but also positions it as a healthier alternative within the ice cream market.

2.2 Projection

As stated by Rodríguez (2023), General Manager of Yamboly Ice Creams, the current per capita ice cream consumption in Peru is approximately 2 liters per year, up from 1.8 liters prior to the pandemic. However, this figure remains below the regional average of 2.5 liters per capita.

To estimate the product's potential demand in the Arequipa market, it is essential to consider the region's demographic evolution. Population projections allow for a more accurate estimation of the growth of the target audience (ages 20–35) and enable the evaluation of market size to assess supply feasibility. In this regard, official data projected by the Vice Ministry of Territorial Governance was used, providing a reliable and up-to-date basis for understanding population dynamics in the city of Arequipa over the coming years (Table 3). This data facilitates a more precise analysis of unmet demand and

the commercial scope of the project. The last two national censuses show steady population growth in the department, increasing from 1,152,303 inhabitants in 2007 to 1,382,730 in 2017.

Table 3. Estimated Population of Arequipa

Year	Arequipa Population
2010	1,224,189
2015	1,327,106
2020	1,497,438
2025	1,631,136
2030	1,755,684

Given that the projected population for the city of Arequipa in 2025 is 1,631,136 inhabitants, and considering the daily per capita ice cream consumption estimated by Rodríguez (2023) at approximately 5.48 ml—compared to 1.8 ml prior to 2020, with an average daily consumption of 4.93 ml—it is estimated that the total daily ice cream demand in the province will reach approximately 9,620.19 liters by the year 2030, as shown in Table 4. When this figure is compared to the current supply, a significant unmet demand becomes evident. This reveals the presence of a large and high-potential market—ideal for the implementation of an ice cream processing facility without major operational constraints. Moreover, based on optimistic projections, the daily consumption rate of 5.48 ml, as indicated by the General Manager of Yamboly Ice Creams, has been maintained for projections for both 2025 and 2030; however, it is highly likely that this figure will increase

Table 4. Ice Cream Consumption Demand of the Arequipa Population

Year	Arequipa Population	Daily Sales (L/day)	Annual Sales (L/year)
2010	1,224,189	6,707.88	2,448,378
2015	1,327,106	7,271.81	2,654,212
2020	1,497,438	8,205.14	2,994,876
2025	1,631,136	8,937.73	3,262,272
2030	1,755,684	9,620.19	3,511,368

However, it is essential to focus on the specific population segment targeted by this proposal, which, as previously mentioned, includes individuals aged 20 to 35. The projected population and corresponding demand for this segment are detailed in Table 5.

Table 5. Ice Cream Consumption Demand by Target Segment and Its Projection

Year	Segment Population	Daily Sales (L/day)	Annual Sales (L/year)
2010	17,662	87.10	31,791.16
2015	19,147	94.42	34,463.83
2020	21,604	118.38	43,208.01
2025	23,533	128.95	47,065.82
2030	25,330	138.79	50,659.60

Over the years, ice cream consumption in the city of Arequipa has shown steady growth, which serves as a favorable indicator for the project's viability. Based on the historical data analyzed, future demand projections have been made for the sector, revealing a positive trend that supports the development potential of this industry in the coming years. Table 6 presents the projected ice cream sales volume in liters for the forecasted periods.

Table 6. Projected Ice Cream Demand for the Target Segment

Year	Annual Sales (L/year)
2020	43,208.01
2025	47,065.82
2030	50,659.60

To determine the unmet demand, it is also necessary to obtain annual production data, particularly for the target segment. For this purpose, historical data from the Ministry of Production was used. However, given that this data is somewhat outdated, a projection was developed to align it with the years under evaluation.

Table 7. Ice Cream Production in Arequipa

Year	Total Production (L/year)	Segment Production (L/year)
2015	1,380,896.28	8,232.30
2016	1,585,527.25	9,452.20
2017	1,774,550.76	10,579.00
2018	1,864,260.28	11,113.60

Based on this data, a projection was developed to estimate the approximate production volume for the target segment, as illustrated in Figure 1.

Thus, by applying the linear equation, we were able to estimate the projected values for the coming years, as shown in Table 8.

Table 8. Offer Projection

Year	Segment Production (L/year)
2019	12,286.95
2020	13,264.02
2025	18,149.37
2030	23,034.72

Based on the joint analysis of supply and demand, it is possible to identify the unmet demand—defined as the portion of the market that has not been adequately served by existing providers.

This gap represents a strategic opportunity to introduce new products or services that more effectively address consumer needs. In the case of this project, the presence of unmet demand reinforces the commercial viability of implementing a personalized ice cream processing facility capable of addressing this unserved space through an innovative and differentiated offering.

Figure 1. Historical Offer

A persistent level of unmet demand can be observed over time, despite the gradual increase in segment production. This situation highlights that the current supply is insufficient to cover the total projected demand, clearly representing an opportunity for new ventures in the sector.

Table 9. Unmet Demand

Year	Segment Demand	Segment Production	Unmet Demand (L/year)
2020	43,208.01	13,264.02	29,775.07
2025	47,065.82	18,149.37	28,522.98
2030	50,659.60	23,034.72	27,006.86

The upward trend in demand, contrasted with the limited capacity of the current market, confirms the existence of available and sustainable space for the entry of an innovative proposal.

3. DESIGN AND DEVELOPMENT OF THE PRODUCTION PROCESS

The production process was structured into three main units. The first unit, referred to as the "Ice Cream Base Preparation," begins with the precise weighing of all ingredients—both liquid and powdered—using an industrial scale and appropriate measuring tools to ensure that each input is dosed according to the established recipe. The dry ingredients are then mixed, which include white sugar (170 g), powdered milk (40 g), carboxymethylcellulose (CMC) as a stabilizer (2 g), salt (1 g), and powdered vanilla (0.5 g) per liter of ice cream. Simultaneously, the liquid ingredients are prepared: 600 ml of water and 160 g of evaporated milk per liter, which are combined in a separate container. Both mixtures are then integrated in a process referred to as Mixing 1, using an industrial mixer that ensures proper homogenization. During Mixing 2, and with the machine still running, 20 g of cream per liter of ice cream is carefully added to achieve a smoother and creamier texture. This process, as illustrated in Figure 2, is collectively referred to as the Mixing of Liquid and Dry Ingredients. The final output of this unit should be a homogeneous base mixture from which the various flavors of the ice cream will be developed.

Once the homogeneous mixture is obtained, the second unit—Raw Material Processing—begins. This phase aims to incorporate the ingredients that will define the product's flavor. In parallel with base preparation, fresh fruits used as flavoring agents are thoroughly washed to ensure hygiene and cleanliness. The selected fruits are then chopped in quantities that vary depending on the type of superfood used: 250 g of aguaje, 60 g of tarwi, or 20 g of spearmint per liter of ice cream to be produced. This step is essential to ensure proper flavor integration into the base mixture.

Once the fruits are prepared, they undergo a final blending stage, where they are combined with the base mixture using an industrial mixer, resulting in a homogeneous mix with the desired flavor. Following this, the mixture is strained using a sieve to remove any lumps or solid residues that could affect the ice cream's texture.

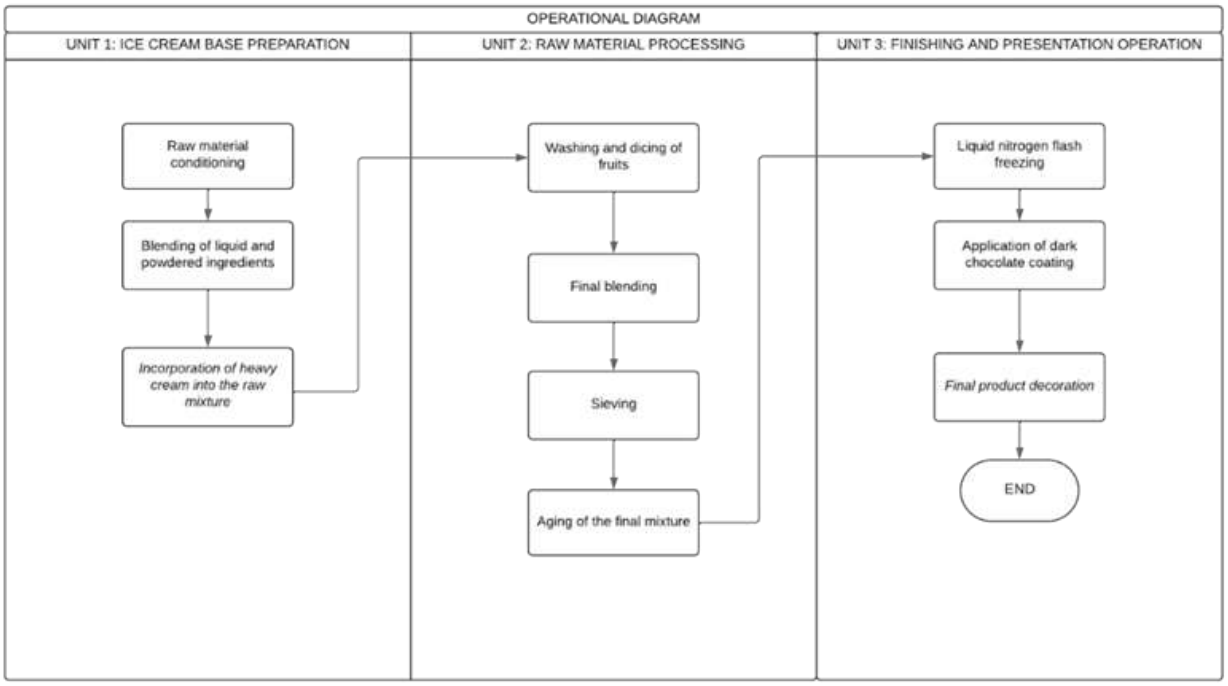

Figure 2 Operational Diagram of the Production Process

Finally, the maturation phase is carried out—an essential process that involves letting the mixture rest for at least 4 hours at 2 °C. This allows the ingredients to fully integrate, stabilize, and reach the optimal temperature for the subsequent freezing stage. The objective of this second unit is to ensure improved texture, consistency, and overall product quality.

Subsequently, while the final mixture undergoes the maturation process, the third and final unit—Finishing and Presentation Operation—begins. This stage includes both the freezing process and the preparation of the product's signature decorative toppings. The process starts with chocolate tempering, a culinary technique that, enables a glossy and crisp finish ideal for decorative pieces. To achieve this, two-thirds of the selected chocolate is melted at 45 °C in a chocolate Melter. Once this temperature is reached, the remaining third is added and stirred with a spatula until a uniform consistency is achieved at 32 °C.

The tempered chocolate is then poured into molds shaped like emojis (eyes, mouths, sunglasses, among others), which are left to set at room temperature and later transferred to a freezer until they reach the necessary firmness.

Once the maturation period concludes, the mixture is frozen using liquid nitrogen, an innovative process that replaces traditional batch freezing. This technique allows for the immediate solidification of the mixture, incorporating air and cold more efficiently. The result is a freshly prepared ice cream with a smooth, creamy texture—crafted at the moment of order—providing a visually engaging experience for the customer.

Finally, the final decoration is applied: the previously molded chocolate toppings are used to personalize each ice cream with various emoji expressions chosen by the customer, enhancing the aesthetic and emotional value of the product.

4. RESULTS AND DISCUSSION

4.1 Data Analysis

The survey conducted among a representative sample of consumers in the city of Arequipa yielded relevant insights into their habits and preferences regarding ice cream consumption. As shown in Figure 3, key takeaways were identified, allowing for a deeper understanding of the target market's characteristics. Among these findings, the primary target segment—individuals aged 20 to 35—stood out and was confirmed based on the responses gathered.

Additionally, a strong preference for experimenting with new flavors was observed among respondents, revealing a significant opportunity for introducing innovative offerings into the Arequipa market. These results confirm the feasibility of offering personalized ice creams with unique flavors that align with the local consumers' trends and expectations.

Moreover, the survey revealed additional findings: 41% of respondents prefer to visit an ice cream store, and 78% expressed interest in trying ice cream with emoji-shaped decorations.

4.2 Determination of the Production Area

To establish the appropriate dimensions and spatial requirements for the implementation of a personalized ice cream processing plant, the Guerchet method will be applied. This tool is widely used in industrial engineering for the efficient design of production facilities. It enables precise calculation of the total surface area required for

each work zone, taking into account not only the size of the equipment but also personnel movement and operational flows.

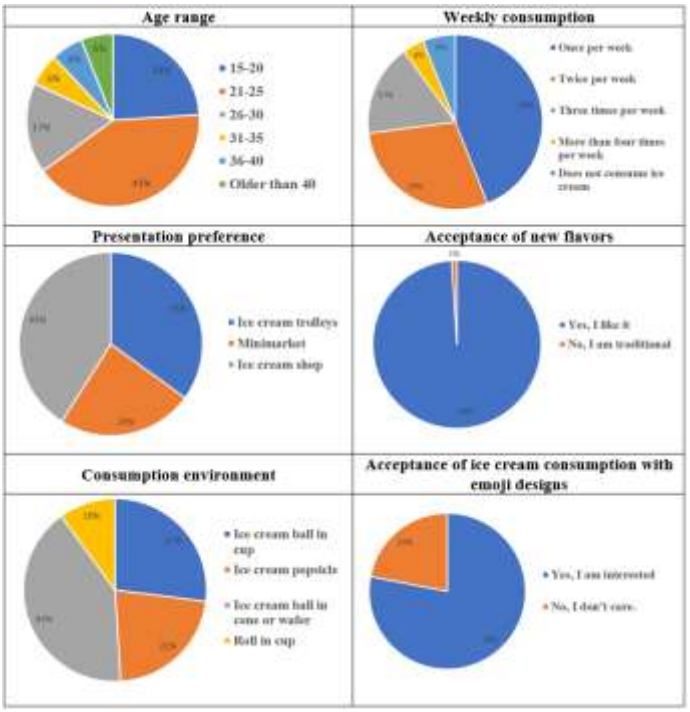

Figure 3. Key Insights

The procedure involves identifying all static and mobile elements—such as machinery, tools, and operators—and classifying the spaces into three components: static surface (occupied by fixed equipment), gravitational surface (circulation and access areas), and evolutionary surface (zones designated for personnel movement and material handling). The following formula is used:

$$\boldsymbol{S_T = \left(S_s + S_g + S_e\right)^{*} n} \quad (1)$$

This equation allows for the calculation of the total surface area required for the plant by combining three main components: the Static Surface (Ss), which includes space occupied by machinery, equipment, and workstations; the Gravitational Surface (Sg), allocated for the storage of raw materials, products in process, and finished goods; and the Evolutionary Surface (Se), which refers to the areas designated for personnel circulation and auxiliary services such as offices, locker rooms, or rest areas. The sum of these areas is then multiplied by an expansion coefficient (n), which adjusts the total area proportionally according to the number of projected production lines, ensuring efficient operation throughout the process (Mukherjee et al., 2020).

By applying this methodology, a functional and ergonomic plant layout is achieved. It optimizes the use of available space and ensures a continuous and logical flow between each stage of production—from base preparation and final mixing to the elaboration and decoration of the final product. This guarantees that the layout aligns with actual operational needs, thereby promoting higher productivity, improved hygiene, and greater safety at every phase of the production process.

4.3 Financial Analysis

To evaluate the profitability of the project in Peruvian soles (PEN), it is essential to conduct a detailed financial analysis to ensure the economic viability of producing and commercializing the ice cream in its various formats. As previously mentioned, this analysis enables the calculation of monthly revenues, which are presented in Table 9. The calculation accounts for the different product presentations and their corresponding monthly sales, allowing for an accurate estimation of the company's cash flow throughout the year. In addition to revenue, it is necessary to determine the production costs, which include both fixed and variable costs, as well as operational expenses. These costs, detailed in Table 10, are critical for conducting a comprehensive profitability assessment, as they allow for identifying the relationship between generated revenue and the expenses associated with the production process, thereby ensuring the business's financial sustainability (Table 11). Furthermore, this section presents the key calculations used to determine the project's profitability through fundamental financial indicators such as Net Present Value (NPV) and Internal Rate of Return (IRR), which are detailed in Table 13. These indicators are calculated based on projected revenues and expenses over the analysis period, as outlined in the cash flow presented in Table 12. The Economic NPV was calculated using a discount rate of 15.09%, determined according to the Weighted Average Cost of Capital (WACC), while the Financial NPV used a rate of 7.62%. The IRR, on the other hand, represents the discount rate at which the NPV equals zero, providing a measure of the investment's efficiency and profitability.

Table 10. Monthly Revenues

Presentation	Flavor	Daily (units)	Monthly (units)	Price	Monthly price
1 scoop in cone	Aguaje	10	300	S/ 6	S/ 1,800
	Spearmint	10	300	S/ 6	S/ 1,800
	Tarwi	10	300	S/ 6	S/ 1,800
	Strawberry	10	300	S/ 6	S/ 1,800
	Chocolate	10	300	S/ 6	S/ 1,800
	Vanilla	10	300	S/ 6	S/ 1,800
2 scoops in cone	Aguaje	5	150	S/ 8	S/ 1,200
	Spearmint	5	150	S/ 8	S/ 1,200
	Tarwi	5	150	S/ 8	S/ 1,200
	Strawberry	5	150	S/ 8	S/ 1,200
	Chocolate	5	150	S/ 8	S/ 1,200
	Vanilla	5	150	S/ 8	S/ 1,200
2 scoops in cup	Aguaje	6	180	S/ 10	S/ 1,710
	Spearmint	6	180	S/ 10	S/ 1,710
	Tarwi	6	180	S/ 10	S/ 1,710
	Strawberry	6	180	S/ 10	S/ 1,710
	Chocolate	6	180	S/ 10	S/ 1,710
	Vanilla	6	180	S/ 10	S/ 1,710
	Total		**3,780**		**S/ 28,260**

Table 11. Production and Investment Data

Years	0	1	2	3	4	5
Annual Sales		S/ 339,122	S/ 341,699	S/ 344,262	S/ 346,844	S/ 349,411
TOTAL REVENUES		S/ 339,122	S/ 341,699	S/ 344,262	S/ 346,844	S/ 349,411
Cost of Goods Sold (COGS)		-S/ 98,953	-S/ 100,304	-S/ 101,648	-S/ 103,001	-S/ 104,347
Mannufacturing Expenses		-S/ 78,825	-S/ 78,825	-S/ 78,825	-S/ 78,825	-S/ 78,825
Administrative Expenses		-S/ 103,377	-S/ 103,377	-S/ 103,377	-S/ 103,377	-S/ 103,377
Depreciation		-S/ 3,311	-S/ 3,311	-S/ 3,311	-S/ 3,311	-S/ 2,949
EARNINGS BEFORE TAXES (EBT)		S/ 54,656	S/ 55,882	S/ 57,101	S/ 58,330	S/ 59,913
Income Tax		-S/ 16,123	-S/ 16,485	-S/ 16,845	-S/ 17,207	-S/ 17,674
NET PROFIT		S/ 38,532	S/ 39,397	S/ 40,256	S/ 41,122	S/ 42,239
Depreciation		S/ 3,311	S/ 3,311	S/ 3,311	S/ 3,311	S/ 2,949
Investment in Tangible Assets	-S/ 22,596					
Investment in Intangible Assets	-S/ 4,928					
Investment in Working Capital	-S/ 31,554					
Residual Value						S/ 9,816
Economic Cash Flow	**-S/ 59,078**	**S/ 41,843**	**S/ 42,708**	**S/ 43,567**	**S/ 44,433**	**S/ 55,003**

Table 12. Projected cash flow for the project

INVESTMENT	Assets	Tangible	S/ 22,596
		Intangible	S/ 4,928
	Working capital	PEN/year	S/ 31,554
PRODUCTION	Depreciation	PEN/year	S/ 3,311
	Costs	Sales	S/ 98,953
	Operating expenses	Production	S/ 78,825
		Administrative	S/ 103,377

Table 13. Economic indicators

Economic Indicator	Value
Economic Net Present Value (ENPV)	S/ 55,100
Financial Net Present Value (FNPV)	S/ 47,437
Economic Internal Rate of Return (EIRR)	60.65%
Financial Internal Rate of Return (FIRR)	97.47%
Payback Period (PBP)	1.40
Benefit-Cost Ratio (B/C Ratio)	1.14

4.4 Sensitivity Analysis

In this study, two scenarios were evaluated to project price evolution through a sensitivity analysis. Based on the prepared cash flow statement, two distinct scenarios were developed, each considering a 5% increase and decrease in both revenues and expenses. The key variables in this analysis are the revenues generated from ice cream sales and the production costs, as their behavior directly impacts the project's economic feasibility.

Constructing these scenarios responds to the need to understand how small variations in these variables could affect the financial performance of the business, particularly in an uncertain economic context.

In the optimistic scenario, the aforementioned revenue increase is projected, possibly due to a rise in demand or the successful implementation of commercial strategies. This growth could stem from positive consumer response and an expanding market environment. Conversely, the pessimistic scenario is defined by a reduction in annual sales relative to the base scenario, potentially reflecting a decline in demand or adverse external factors affecting product acceptance. These scenarios and their corresponding financial indicators are detailed in Table 14, allowing for a more accurate assessment of the project's financial performance under different conditions.

Regarding production costs, a 5% increase in expenses is considered, driven by potential rises in raw material prices or increases in operational costs, such as transportation and other variable expenditures that contribute to the project's total cost structure. This increase may be associated with fluctuations in input prices or changes in supply chain conditions. However, in the most favorable scenario, it is assumed that production costs will remain stable, which would be feasible if no significant changes occur in the market environment or supply chain logistics

Table 14. Scenario Comparison

	PESSIMISTIC		**PROBABLE**		**OPTIMISTIC**	
	Economic	Financial	Economic	Financial	Economic	Financial
NPV	S/ 23,070	S/ 22,613	S/ 55,100	S/ 47,436	S/ 87,130	S/ 72,260
IRR	44.32%	70.45%	60.65%	97.47%	76.35%	124.90%
PBP	1.75 (1 year and 9 months)		1.4 (1 year, 4 months and 24 days)		1.17 (1 year, 2 months and 1 day)	
B/C Ratio	1.10		1.14		1.18	

5. CONCLUSIONS

Sustainable production of personalized ice cream represents an innovative and beneficial strategy for both the food industry and the local economy. From a nutritional perspective, ice creams made with functional ingredients such as tarwi, aguaje, and spearmint stand out for their high content of proteins, vitamins, and minerals, making them a healthy and appealing option for consumers. Leveraging these regional ingredients not only contributes to the diversification of the Peruvian food market, but also promotes healthier and more environmentally sustainable eating habits.

In developing this proposal, it is essential to consider the operational diagram of the production process, as it enables visualization and optimization of each stage involved in the elaboration of personalized ice cream. Based on the surveys conducted, key insights were obtained that helped define the strategic focus of the project, including the target segment, consumption frequency, and public acceptance of the proposed product format. The results were favorable, reinforcing the business model's viability and the market acceptance of the product. These insights not only revealed critical opportunities to improve resource management within the plant but also provided valuable information about consumer preferences, which enhances the decision-making process. Additionally, the Guerchet method will be applied to calculate the required production area, ensuring that the facility is efficiently designed and productivity is maximized. This approach guarantees that the production process will be profitable, sustainable, and aligned with operational needs, ultimately strengthening the project's long-term profitability.

The financial analysis conducted confirms the project's viability by calculating key indicators such as the Net Present Value (NPV), Internal Rate of Return (IRR), Payback Period (PBP), and the Benefit-Cost Ratio (B/C). In this case, an economic NPV of S/ 55,100 and a financial NPV of S/ 47,437 were obtained. Likewise, the economic IRR was calculated at 60.65%, and the financial IRR at 97.47%. The payback period was found to be 1 year, 4 months, and 24 days, while the benefit-cost ratio yielded a value of 1.14. These results indicate that the production of personalized ice cream is both viable and profitable. A high IRR suggests returns exceeding the cost of capital, while a positive NPV confirms that future revenues will significantly surpass the associated costs.

Regarding the scenario analysis, it provides a useful tool for anticipating potential risks and opportunities and emphasizes the importance of implementing flexible pricing and cost management strategies to ensure the project's adaptability under varying economic conditions. This approach highlights the need for continuous monitoring of external factors such as raw material price volatility and market trends, to respond promptly to unexpected changes. In this context, the project offers an innovative and sustainable proposal that enhances the nutritional value of ice cream while leveraging local ingredients—standing out from conventional alternatives.

Nonetheless, there are areas for improvement that could be addressed in future research. One potential line of inquiry could focus on optimizing the production process by exploring new technologies that enhance resource efficiency—such as water and energy use—or further reduce waste generation during manufacturing. It would also be worthwhile to explore the development of new

presentations and ice cream flavors, particularly functional products that could expand the project's economic and nutritional impact.

The limitations identified do not invalidate the findings; however, they must be taken into account when interpreting the results to ensure that projections and conclusions remain as closely aligned as possible with real market conditions and large-scale production dynamics. It is recommended to conduct larger-scale pilot studies to confirm that the process remains equally efficient as production scales up.

References:

Barry-Ryan, C., Vassallo, M., & Pojić, M. (2020). The Consumption of Healthy Grains: Product, Health, and Wellness Trends. *Innovative Processing Technologies for Healthy Grains*, 227-249.

Barrett, E. (2024). Neglected and underutilized species: promoting valuable crops in organic agroforestry systems. In *Integrating Landscapes: Agroforestry for Biodiversity Conservation and Food Sovereignty* (pp. 101-126). Cham: Springer International Publishing.

Battini, D., Faccio, M., Persona, A., & Sgarbossa, F. (2011). New methodological framework to improve productivity and ergonomics in assembly system design. *International Journal of industrial ergonomics*, *41*(1), 30-42.

Casanave, M. & Ruiz, R. (2022). Evaluation of the Nutritional Contribution of Germinated and Ungerminated Grains of Quinoa, Amaranth (Kiwicha), and Canihua. (Master's thesis, UNIFE).

Gomez Cahuata, J. F., Rosas-Quina, Y. E., & Pachari Vera, E. (2022). Cañihua (Chenopodium pallidicaule Aellen) a promising superfood in food industry: a review. *Nutrition & Food Science*, *52*(6), 917-928.

Instituto Nacional de Estadística e Informática (INEI). (2024). *Peruvian population situation 2024 a look at ethnic diversity*. https://cdn.www.gob.pe/uploads/document/file/6616587/5751291-situacion-de-la-poblacion-peruana-2024-una-mirada-de-la-diversidad-etnica.pdf?v=1720728622

Kotler, P. &, G. (2012). *Marketing* (14.ª ed.). Pearson Education

Leiva, K. (2024). Pre-feasibility study for the production and Marketing of Artisanal Ice Cream Made from Exotic Fruits of Peru with Chocolate Coating for Socioeconomic Segments A and B in Metropolitan Lima. [Undergraduate thesis, Pontificia Universidad Católica del Perú]. Repositorio Institucional PUCP. https://tesis.pucp.edu.pe/items/5b4c1f43-3b4d-4a5f-86ee-e5c503421fc6

Moreno-Quispe, L. A., Espinoza-Espinoza, L. A., Mauricio-Sandoval, E. A., Palacios, M. S. A., & Portalatino, E. J. V. (2023). Ice cream consumption preferences in Sullana, Peru. *Current Research in Nutrition and Food Science*, *11*(1), 267.

Mukherjee, A., Mitchell, W., & Talbot, F. B. (2000). The impact of new manufacturing requirements on production line productivity and quality at a focused factory. *Journal of Operations Management*, *18*(2), 139-168.

Neumann, W. P., Winkel, J., Medbo, L., Magneberg, R., & Mathiassen, S. E. (2006). Production system design elements influencing productivity and ergonomics: A case study of parallel and serial flow strategies. *International journal of operations & production management*, *26*(8), 904-923.

Popkin, B. M., & Reardon, T. (2018). Obesity and the food system transformation in Latin America. *Obesity Reviews*, *19*(8), 1028-1064.

Rodriguez, D. (2023, 12. April). *Ice cream: Consumption growth in Peru and these are the main brands competing in the market*. [Interview]. El Comercio website archive; Diario El Comercio. https://elcomercio.pe/economia/dia-1/helados-asi-avanza-el-consumo-en-el-peru-y-estas-son-las-principales-marcas-que-compiten-en-el-mercado-donofrio-yamboly-artika-campana-de-veramo-2023-noticia/

Rodriguez, M. (2024). *Five out of ten Peruvian families consume one ice cream per week*. [Interview]. RPP website archive; RPP Noticias. https://rpp.pe/economia/economia/cinco-de-cada-diez-familias-peruanas-consumen-un-helado-a-la-semana-noticia-1531571?ref=rpp

Carmen Villanueva
San Pablo Catholic University,
Arequipa,
Peru
cvillanuevad@ucsp.edu.pe
ORCID: 0000-0002-7647-1111

Ayrton Sotomayor
San Pablo Catholic University,
Arequipa,
Peru
ayrton.sotomayor@ucsp.edu.pe
ORCID: 0009-0008-6150-3644

Diego Liñan
San Pablo Catholic University,
Arequipa,
Peru
diego.linan@ucsp.edu.pe
ORCID: 0009-0001-5880-7160

Jorge Zeballos
San Pablo Catholic University,
Arequipa,
Peru
reymy.zeballos@ucsp.edu.pe
ORCID: 0009-0001-3373-7514

Cristina del Rocío Tejada
San Pablo Catholic University,
Arequipa,
Peru
ctejada@ucsp.edu.pe
ORCID: 0009-0003-8531-9159