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# Feasibility Study of an Ice Cream Manufacturing Business Plan

Research Article

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**Abstract**

This project is aimed to study a feasibility for the establishment of a medium sized frozen plant ice cream manufacturing company at Sendafa town, Ethiopia. Ice cream products represent a growing market opportunity, within the global health and wellness market, for food manufacturers that develop consumer-led additional option products to the current available products with added value levels, which ultimately gain consumer acceptance like many other firms all over Ethiopia. Ice cream is a frozen blend of a sweetened cream mixture and air, with added flavorings and one of the popular dairy products among consumers of all ages. Its textural attributes were the key factors determining the market success of the product. It is a microcrystalline network of liquid and solid phases. One of its compositional contents, fat, also exerts good effects on body, texture, palatability, flavor intensity, emulsion formation and maintenance of melting point. If fat contents exceed a specific usage concentration, they cause faster meltdown of ice cream along with destabilization and agglomeration of fat droplets. Higher overrun results in collapsing of air cells ultimately shrinkage of structure occurs. Hardness might also reduce as a result of smaller ice crystals due to high overrun values. Fiber addition causes the binding of free water hence flow rate gets reduced and consistency coefficient as well as viscosity enhanced. Binding of water results in less availability of its molecules; freezing point rises and melting point decreases. It is much critical to control the balance ice cream properties by maintaining its structure, texture and body. It is a best carrier for fruit fiber, chunks, purees, paste, concentrates; milk and whey isolates and concentrates; egg, egg yolks and their products; different flavorings, nuts, chocolate, probiotics and yogurt. So far, it is important to maintain its solid contents and structure with balanced proportion of ingredients. Generally, Payback period is less than one year. A shortest payback period has less risk than with the project with longer payback period. The payback period is often used when liquidity is an important criterion to choose a project. The project is risk free and feasible project with high demand.

**Keywords:** Ice Cream; Strategy; Properties; Technology And Engineering; Market Evolution; Market Analysis.

## Introduction

Ice Cream is a frozen emulsion of air bubbles, ice crystals, milk fat globules, colloidal proteins, and gums suspended within viscous syrup, the continuous phase. It is a dairy product prepared by pasteurization, homogenization, and aeration and freezing that has been maintained at uniform consistency. Composition of ice cream is comprised of sugar, fat, emulsifiers, stabilizers, water, egg and eggs products, corn syrup, dextrose and flavors. It is a three-phase network consisting on air, solid and liquid in final product. Liquid phase contains ice crystals in embedded form and air cells in dispersed form. Milk proteins, soluble and insoluble salts, fat particles, stabilizers and sugars are also present in liquid phase. So it is a very complex physiochemical food system. Ice cream is categorized in dairy frozen desserts in which frozen confections, water ice, sherbet, frozen custard, pare vine like products, ice milk and mellorine are included.

The type of milk protein can affect the stability of the air cells in ice cream. Sodium caseinate contributes to aeration and emulsification of ice cream mixes, but it does not function the same as micellar casein [4]. Although it increases the stability of air cells, it may render the emulsion so stable that adequate churning does not occur in the freezer. As with fat, proteins have little effect on freezing point except as they displace water. Milk proteins are hydrated, and the degree of hydration increases during high-temperature pasteurization because of the unfolding of protein structures. Therefore, high heat treatment may be used to

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minimize or eliminate the need for stabilizers in frozen desserts. Freeze-concentration of proteins in ice cream greatly increases the viscosity of the unfrozen phase, and this has a great effect on ice crystallization, ice crystal stability, and solute mobility [3].

Sugar alcohols are used to replace conventional sweeteners in sugar-free frozen desserts. Because they have a much lower glycemic index than sugar and corn sweeteners, they provide solutions for formulating frozen desserts for insulin-dependent diabetics. Included in this group of mono- and disaccharide sugar alcohols (the polyols) are sorbitol, mannitol, xylitol, erythritol, lactitol, maltitol, isomalt, and some related hydrogenated starch hydrolysates (Nabors, 2001, 2002). Stabilizers are added to ice cream for the primary purpose of affecting the texture. The consumer usually desires a velvety-smooth product with a moderate rate of melt, limited coldness, and a uniform distribution of particulates. Stabilizers contribute to these properties by absorbing water (therefore swelling) and limiting its migration, increasing viscosity, adsorbing to air cell lamellae, and, in some instances, forming a gel-like structure. At high concentration, they interact and become entangled with each other, greatly modifying the rheological characteristics of solutions. Stiffness added by stabilizers to ice cream exiting the freezer barrel promotes easy cut-off of extruded products and efficient packaging. The major contribution to quality is the retardation of growth of crystals of ice and lactose. The amount of natural emulsifier in an ice cream mix is fully adequate to stabilize the newly formed globules, the rate of agglomeration of these globules is usually too low to provide the most desirable ice cream structure. When emulsifiers are added, the native globule membrane is substantially displaced by the emulsifiers and adsorbed proteins, and the surface area on the fat globules is increased markedly. The extent of adsorption of these molecules depends on their concentrations and individual physical properties [5]. The Objectives of this study is to assess the feasibility study of ice cream manufacturing plant in Ethiopia Product.

## Ice Cream Manufacturing Project Strategy

The project strategy is to compute and penetrate the local market in the sector of ice cream industry with another option of high quality and hygienic product at reasonable prices with short- and long-term goals. It is intended also to maintain a significant price parity between the competitors so as to increase its market share of the food industry.

This project idea is being promoted in line with the following government industrialization and general development policies: the Government policy on GTP's plan on agricultural-processing and industrialization is pertinent to this first; the Ethiopian commodity market in a transparent, fair and sustainable manner that would benefit all the actors in the value chain and the country at large. Through the sourcing of raw materials locally within the region, this project is therefore, envisaged to have a trickle-down effect on employment and income generation to the local inhabitants especially the small-scale farmers and business men and women.

### Demand projection

It indicates that most of current ice cream processed products have deficiencies with regard to meeting the current demand of market. Hence, the coming with alternative ice cream manufacturing product is recommended to show good option in ice cream products.

❖ Quality Control/ Product quality: To ensure that the ice cream is handled in such a matter that it is safe for human consumption, of the employees will take a safe food handlers' course. Additionally, the building will be approved by the health and drug administration to meet strict guidelines for the safety of the employees and customers.
❖ Packaging: The packaging material used by existing producers is selected accordingly to the customer preference and availability in local market. Therefore, its adoption by the upcoming processing factory has been suggested.

### Product description

In this study extruded plain ice-cream product with the assumption of: white to pink color with white plastic pails; with packaging level of 250 gram of containment; Taste: medium sweet +additives;

❖ Raw materials: Dairy products (milk, cream, butterfat), Sugar, Avocado Fruit, Corn starch, Stabilizers, Emulsifiers, Water
❖ Ingredients: Food grade additives and the range will be finding out according to local preferences
❖ Natural flavors of orange with mango, and colorants from bakery ingredient suppliers.
❖ Those the Approved additives to prevent creation of ice crystals during production process, Air which improves ace cream's ability to absorb flavoring.
❖ The current product aims to contain at least 10% milk fat, and at least 20% total milk solids, and may contain safe and suitable sweeteners, emulsifiers and stabilizers, and flavoring materials.

## The Manufacturing and Compositional Properties Of Ice Cream

### Blend the Ice Cream Mixture

The milk fat source, nonfat solids, stabilizers and emulsifiers are blended to ensure complete mixing of liquid and dry ingredients.

**Pasteurize Mix:** Ice cream mix is pasteurized at 155°F (68.3°C) for 30 minutes or 175°F (79.4C) for 25 sec. The conditions used to pasteurize ice cream mix are greater than those used for fluid milk because of increased viscosity from the higher fat, solids, and sweetener content, and the addition of egg yolks in custard products.

**Homogenize:** Ice cream mix is homogenized (2500 to 3000 psi) to decrease the milk fat globule size to form a better emulsion and contribute to a smoother, creamier ice cream. Homogenization also ensures that the emulsifiers and stabilizers are well blended and evenly distributed in the ice cream mix before it is frozen.

**Age the Mix:** Ice cream mix is aged at 40°F (5°C) for at least 4 hours or overnight. Aging the mix cools it down before freezing, allows the milk fat to partially crystallize and the gives the proteins stabilizers time to hydrate. This improves the whipping properties of the mix.

**Add Liquid Flavors and Colors:** Liquid flavors and colors may be added to the mix before freezing. Only ingredients that are liquid can be added before the freezing, to make sure the mix flows properly through the freezing equipment.

**Freeze:** The process involves freezing the mix and incorporating air. Ice cream mix can be frozen in batch or continuous freezers and the conditions used will depend on the type of freezer. Batch freezers consist of a rotating barrel that is usually filled one-third to one-half full with ice cream mix. As the barrel turns, the air in the barrel is incorporated into the ice cream mix. Ice cream freezers designed for home use are batch freezers. Continuous freezers consist of a fixed barrel that has a blade inside that constantly scrapes the surface of freezing barrel. The ice cream mix is pumped from a bulk tank to the freezing barrel and the air is incorporated with another pump just before it enters the freezing barrel. The continuous freezing process is much faster than the batch freezing process.

**Add Fruits, Additives:** Fruits, additives are added at this point. These ingredients cannot be added before freezing or they would interfere with the smooth flow of the mix through the freezer. The ice cream at this point is soft and it is easy to mix in the additives so they are uniformly distributed throughout the ice cream. Mixing after freezing also prevents damage to the pieces and allows them to remain whole or in large chunks.

**Package:** As desired, depending on the product.

**Harden:** The ice cream is cooled as quickly as possible down to a holding temperature of less than -13°F (-25°C). The temperatures and times of cooling will depend on the type of storage freezer. Rapid cooling will promote quick freezing of water and create small ice crystals. Storage at -13°F (-25°C) will help to stabilize the ice crystals and maintain product quality. At this temperature there is still a small portion of liquid water. If all the water present in the ice cream were frozen, the ice cream would be as hard as an ice cube.

**Compositional Properties of Ice cream**

On the basis of calorimetric measurements, 9.45cal/g contributed from fat; 5.65 Cal/g from proteins and 4.10 Cal/g from carbohydrates. All material is not absorbed in the body hence actually energy derived from fat, protein and carbohydrates is 9, 4 and 4 respectively [2]. Various ingredients are available in market for ice cream that have important effects on ice cream quality. These ingredients can be categorized in dairy and nondairy components from many sources. Various ingredients that affect the quality of ice cream include sugar, fat, water, emulsifiers and stabilizers.

**Sugar:** Sugar either in liquid or solid dry form added in ice cream up to 12-20% but 14-16% is the preferable level. Corn syrup can be added to replace 45% sugar in ice cream to handle, store and economic purposes. Among various commercially available sugar blends, solids of corn syrups-low conversion preferred because they don't affect the characteristics of ice cream and enhance the total solids. Sucrose performs various functions in ice cream including.

**Functions:** Optimum palatability; Maintain handling properties; Acceptability of ice cream; Sweetens the product; Increase pleasing sweet flavor; Enhance solid contents and viscosity; Texture and body improvement.

**Defects:** Higher sugar addition causes bad effects like; Bland taste due to lacking sweetness; Mask desired flavor; Soggy ice cream above 42% TS; Freezing point depression; Freezing slow down; Hardening require low temperature.

**Total solids:** Total solids include the sum of all solid and dry ingredients of ice cream. Fat, sugar, stabilizers and emulsifiers all contribute to total solids. Water is replaced by total solids in ice cream mix. Properties of ice cream are specially improved by the addition of solids of buttermilk and egg yolk, sweet cream and eggs.

**Functions:** Texture and body improvement; Whip ability improvement; Freezing point reduction; Increase overrun with increased total solid (TS)

**Defects:** Decreased cooling effect during summer associated with increased TS; Soggy and heavy structure with TS up to 40-42.

**Water**: Mostly ignored but very influential component present in ice cream air and water. Water maintains the continuous phase in ice cream either by adding as solid or liquid form. Products from dairy origin must be purified while it is expected that water of milk source has been cleaned already during its passage and excretion from memory glands.

**Functions:** Act as solvent; Provides liquid medium, [2].

**Air**: During ice cream preparation, overrun is created by incorporating air in mixture to enhance the volume. Quality of ice cream is influenced by amount of air incorporated. Quality of product can be controlled by uniform addition of air. Air quality itself is maintained by filters installed in freezers. Emulsifiers, fat and protein in unfrozen state cause the stabilization of air and water interface by forming thin film. Fat globules, ice crystals and water from the emulsion and entrap the air.

**Functions:** Increase the volume; Meeting legal standards; Increase profit; Product and quality control and Affect quality.

**Defects:** Air incorporation above certain level causes defects in ice cream; reduced ice crystals size; Reduction in melting point; Low hardness for the injection of nitrogen instead of air, various researches have been performed. It was reported that rate of oxidation was reduced with incorporation of nitrogen [7, 8].

**Stabilizers:** Basic types of stabilizers added in ice cream are of two sources; Animal source (gelatin from bones and calf skin), Plant or vegetable source (gums (agar-agar, carboxymethyl cellulose, sodium alginate, acacia, oat, carrageenan and karaya)). Water binding capacity of stabilizers is very high and added in small quantity hence effect on flavor and product value is inconsequential. Total solids, processing machine, stabilizers properties and some other factors affect the usage of stabilizers.

**Functions:** Smoothens the texture; Provide body to the product; Enhance viscosity; Freezing point not affected; Prevent from texture coarsening; and Provide resistance during melting.

**Defects:** Restrict whip ability; Heavy and soggy structure; Undesirable melting properties

**Emulsifiers:** During manufacturing of ice cream, emulsifiers are added to smoothen the texture and thorough distribution of air cells. Mono and di-glycerides are most common emulsifiers used in ice cream plants. Emulsifiers are not be used more than 0.2% on weight basis. Polysorbate and sorbitan tristearate up to 0.1% are now allowed in dairy products as safe.

**Functions:** Stiffness to body and smoothness of texture; Reduction in time of whipping; even whip ability properties; and Smaller uniformly distributed air cells.

**Defects:** Emulsifiers when used in excessive quantity because defects like slower melting, Textural and body defects.

**Egg yolk:** It is highly valuable in foods and helps in other flavors blending for desirable properties. Ice cream cost is increased by egg yolk addition. It provides desirable flavor to ice cream but if product of egg has any off flavor that can be easily detectable in ice cream with egg. Protein and lecithin complex in egg yolks is highly preferred in mixes where total solids are lowered and prepared with butter oil or butter.

**Functions:** Delicate characteristic flavor; Texture and body improvement; Viscosity increase; and Improved whip ability.

**Defects:** Off flavor in egg yolk detectable in final product

**Flavors:** Flavor can be easily mistaken as taste or feel sensation. It is very important ice cream property and resulted from mixed flavor of all ice cream components. Individual taste of any ingredients has effect on “flavor blend” or “specific flavor” so it makes difficult in detection of specific ingredient effect on ice cream flavor. Important properties of flavor are intensity and type. They may be mild or harsh. Harsh flavors at even low concentration soon turn monotonous but mild flavor can be blended easily and at higher intensity they don’t turn into monotonous. So delicate and mild flavors are generally preferred. Flavor must be detected easily and provides refreshing taste in all conditions.

**Properties of balanced ice cream mix**

A mix is named balanced if it has all ingredients or components proportion in a way that results in fine and desirable ice cream. If defects are present, they may not be eliminated by changing proportion of constituents and not resulted from poor mix balancing. Such defects are; Flavor rancidity, Lacking of uniformity in color, Base flavor, some defects that resulted from poor balancing but can be corrected by alteration in mix proportion are; Insufficient fat concentration and richness lacking, Insufficient flavors percentage, Sandiness due to Weak body due to less stabilizers and TS [2].

## Raw Materials of Work Plan

The ingredient and product mix of the current ice cream manufacturing work plan.

**Ingredients: Fruit**

**Fresh Fruit:** The majority of the fresh fruit that will be included in making the ice cream will be added to market inventory periodically throughout the summer months as the fruit ripens. Upon ripening, the following fruit required to make the ice cream will be purchased from local market and or directly from farm agricultural linkage.

**Process Fruit:** Wash, pit, and sort Dwarf Sour cherries using cherry pitter and sorting table. The cherries are placed on the sorting conveyor which carries the cherries to the pitter where they will be sorted and de-stemmed. As the cherries reach the end of the conveyor they will fall into a basket at the pitter. The cherries will then be loaded into the pitter and come out in front of the packing table. At this table the pitted cherries will be vacuum sealed before being taken directly to cold storage: Wash, peel and core Avocado; Wash and cut banana and Wash and sort limon.

**Ice cream mix**

The general composition of an ice cream mix is as follows (Agriculture and Agri-Food Canada, 2007) [1]: Milk fat: >10% - 16% by legal definition, ice cream must have greater than 10% milkfat, and usually no higher than 16% fat in some premium ice creams: Milk solids-not-fat: 9% - 12%. This component is also known as serum solids and contains the proteins (caseins and whey proteins) and carbohydrates (lactose) found in milk: Sucrose: 10% - 14%, Corn syrup solids: 4% - 5%, Stabilizers: 0% - 0.4%, Emulsifiers: 0% - 0.25%, Water: 55% - 64% and Fruit: 28% - 40%. The ingredients in an ice cream mix that are required to supply the desired components of the ice cream are chosen on the basis of availability, cost, and desired quality. The current manufacturing industry have in line with ice cream mix as in range above product formulation.

## Location and Site of The Proposed Project

Location of the envisaged integrated ice cream is selected based on a two-stage Location and site selection procedures. The first stage involved identifying potential project locations, and prioritizing and selection of appropriate one based on critical project selection criteria. The project location determining factors considered in the study are supply of raw materials and inputs, access to market, availability of skilled and unskilled labor, infrastructure such as road, electricity and telephone line, availabilities of social amenities – hospitals, schools, training centers and residence housing, etc. The second stage of project location and site selection procedure involved – identifying alternative project locations within the selected project location and selection of the optimum project site from the proposed sites.

**Location selection**

Plant location refers to the choice of a geographical area for setting up a plant. The location of a plant is a strategic and long-term investment decision that, if once made, is difficult to change and that causes considerable loss. Location has a strong and long-term influence on the success of the plant; therefore, due care has to be exercised for selection of optimum project location. Various determining factors have to be taken into account. In process of the project location selection, the Consultant has adopted two stage selection processes for the envisaged plant. The first stage is the identification of potential geographical locations based on the assessment of critical project requirements. The second stage involved selection of the best location from the potential locations identified using different selection criteria and as well as established rating scale.

### Site selection

**First Stage of Potential Location Selection:** During the first stage plant location selection, critical project requirements of the envisaged plant were identified, and possible potential locations were identified based on the availability of these critical project requirements. The location to be selected for the commercial ice cream manufacturing industry has to fulfill the key requirements identified as essential or critical for a feasible and viable implementation and operation of the plant. These critical requirements of the envisaged project comprise of raw materials supply, supply utilities such as water and electricity, labor, land, road/transport facility, and other necessary infrastructures. These critical project requirements are discussed briefly hereunder. Accordingly, around integrated Hawassa industrial park, towns of Addis Ababa city, Sendafa towns were proposed as potential candidates.

**Second Stage of Potential Location Selection:** The second stage of selection of a specific location among the identified potential locations for the envisaged ice cream processing plant involves the following Procedures: Identification of manufacturing (selection criteria); Assigning weight for each factor identified above according to the relative importance of the factors for the installation and operation of the envisaged mini brewery processing plant; Finally, the identified potential locations are ranked in a scale constructed in such a way as to magnify the relative importance of the location for the installation and operation of the plants. Each factor is given a rating score, which could be high, medium or low. Multiplication of factor weight with the corresponding rating score yields weighted average (rating index) for each location. By so doing, the location with the highest rating index is selected for the installation of the plant. Accordingly, from the four proposed potential location candidates Sendafa towns was selected as an optimal project site.

## Technology and Engineering

### Technology

The technology selection for the main product ice-cream compared medium commercial technologies. Ice Cream manufacturing plant processes are based on a common, yet modern approach of mixing, pasteurization, homogenization with continuous agitation and to get consistence yield. Processing operations for ice cream can be divided into two distinct stages: mix manufacture and freezing operations. Ice cream mix manufacture consists of combination and blending of ingredients, batch or continuous pasteurization, homogenization, and mix aging. The Production steps of Ice cream are as listed below:

1. Initial mixing of materials, pasteurizing (heating at high temperature to kill of any harmful bacteria) and homogenizing (thorough mixing of the cream in attempt to break down any fat globules until the mixture is perfectly smooth and uniform).
2. After the addition of flavors, colors and fruit purees, mix is left to stand for around four hours to cool down.
3. Special barrel freezer machine then takes the mix and gradually freezes only one part of the water crystals making the mix harder. During the same time, machine also pumps clean air into the ice cream, which by the end will hold over 50% of the ice cream volume. Without that air in its structure, ice cream would be hard as an ice cube.
4. Semi frozen mixture is then introduced with the final mix of toppings, such as fruits, nuts, sweets or biscuit mix.
5. At the end, ice cream is packaged and blast-frozen to the temperature between -30 and -40 degrees Celsius.

### Engineering

**Technical Assessment:** The major components of the formulation ice cream manufacturing industry are the machinery and equipment of the ice cream processing and buildings and the civil works which take the highest portion of the investment costs. In addition to the ice cream manufacturing machineries and equipment's, there are facilities without which the successful operation of the envisaged project cannot be accomplished. These facilities include land, utilities, workshops, water and wastewater treatment plants, etc. and human resource. These are briefly described below.

**a) Land:** the estimated area requirement for the envisaged project is about 1.5 Hector as part of an integrated processing plant that would be established for Ice cream manufacturing. An additional area of 1.5 Hector will be reserved for future expansion of the formulation plant.

**b) Water:** the demand for water in the Ice cream processing plant is quite different. Some water is used for cleaning, human consumption as well as for gardening. Water is available from the Municipality of Sendafa town.

**c) Electric Power:** the power requirement for the operation of the plant machinery and equipment is estimated at 250 KW while about 10 KW is sufficient for internal and external lighting requirements. Accordingly, a transformer with a capacity of 325 KVA is required for the ice cream manufacturing from where power is sent to the distribution / control panel. Power is used at a rated voltage of 100V for most of the operation of the machinery and equipment in the processing plant. Moreover, a standby diesel electric generator of 31.125 KVA will need to be installed for safe shutdown of the plant and to maintain continued power supply got lighting and communication purposes.

**d) Compressed Air:** the plant shall have a compressor for generation of compressed air with air drying system to ensure low dew point such that pneumatic control systems operate safely.

## Marketing and Customer Analysis

### Competitive Analysis

Relatively of homemade ice cream producers in Addis Ababa, but many of them do not produce on a large scale. The threat of entry into this industry is relatively high considering that small-scale ice cream producing equipment can be purchased at a reasonable price and there is a wide array of types of ice cream that can be made. The power of buyers of ice cream in this market is moderate to high as ice cream is a price elastic product and buyers can easily switch between producers. To limit this power, suppliers of ice cream must target buyers who will purchase large quantities of ice cream, and in turn this will create brand loyalty. The power of the suppliers of ice cream is moderate due to seasonal demand for ice cream and changing consumer preferences, but premium ice creams command higher prices. There is also a high threat of substitutes in this industry as there are many types of ice creams, ice cream products, and multiple locations to purchase them from. Thus, competitive rivalry in this market is high as ice cream is in the maturity stage of its product life cycle and needs to be positioned to a niche market in order to gain market share. Sendafa towns competitors include any of those ice cream producers who have ice cream products available for sale in Addis.

### Customer Analysis & Segmentation

Ice cream producers must stay competitive because ice cream consumers tend not to be very loyal unless purchasing ice cream in large quantities for conventions and other functions.

**Target Markets:** The social community event segment includes local fairs, weddings, and other community banquets. Both this segment and the hotel and convention center market allows for ease of entry with contracts and minimizes costs through bulk sales.

**Product Features:** Good ice cream is a homemade product that can easily be tailored to suit individual tastes and preferences. The inclusion of locally grown fruit and milk products relates to positive aspects of supporting Saskatchewan made products.

**The Opportunity:** Therefore, must be positioned as offering a unique product with high quality and premium prices reflecting this. The product must be positioned in a manner so that customers will see this company as providing a flexible service that can tailor the ice cream to meet individual needs.

### Marketing Strategy

### Key Planning Assumptions

➢ provides a unique and adaptable product that fits well into a market where consumers are looking for a quality local ice cream product they can tailor to their needs
➢ will strive to capture off-season sales through the superior quality and taste of their product that will leave customers desiring the product in winter months
➢ will target the segment of the market that values quality over price
➢ Targeting the upscale restaurant, hotel, and convention centers to design their own signature ice cream will differentiate from their competition.

### Channels of Distribution

A local ice cream supplier and the inventory travel time between the ice cream processing facility and the final destinations will be minimal. Consumers will be using contracts to purchase ice cream and this will ease distribution as there will not be a set route of distribution each week. A Freezer Van will be purchased to allow for ease of distribution.

### Pricing Policy

It will be chosen a market-based approach to its pricing policy.

### Marketing Plan of the Marketing Mix (4 P's)

**Products:** The current product will sell 250L quantities of premium ice cream. The ice cream will be packaged in white plastic pails. Each pail will have a label listing the company name and address, the product name, the net quantity in the pail, a best before date, a list of ingredients, and the company's logo. Nutritional information will be provided on a hand out sheet.

**Pricing:** The product will target a high-end use market via hotels, upscale restaurants and convention centers. The ice cream will be priced at $1.25 for a 250ml tubs of the premium product. The product will be sold in a very competitive, but profitable market. The intensity in which the manufacturing company will penetrate the premium contract market for ice cream will create consistent profitability for the business.

**Promotion:** The ice cream manufacturing industry will employ a variety of promotional techniques. Pamphlets, websites, Mainstream media and face-to-face interaction will be the focus. Along with these techniques, sampling will be a way in which the company can acquire new clientele. Pamphlets will allow customers to learn more about the ice cream selection and image. A website will be constructed to allow potential and existing customers of the sector to place orders, view product information and discover the image of the current particular product. Costs will be associated with this website to keep it secure and functioning properly. Face-to-face selling will also allow to a personal connection with their customers.

**Place:** The geographical target market includes all of Sendafa town, with an initial emphasis on high-end restaurants, hotels and conventions centers in and around Addis. The product will distribute their product to the target market in Addis Ababa and area by means of the delivery vehicle purchased.

### Strength Weakness, Opportunity and threat (SWOT) Analysis

Table 1

## Financial Analysis

### Building and civil work construction

A building permit must be acquired before this building can be erected. The cost of the building permit is included in the cost of the main processing facility. This building will fall in to both the agricultural and commercial tax levels. Therefore, the building will have multiple tax designations and each of these classifications corresponds to different tax levels.

### Infrastructure Development

The building will encompass all fruit processing and storage as well as all of the ice cream processing equipment and storage. It will be a serviced building with heat, water, and sewer. A walk-in freezer, including floor and recessed door, will be installed in this building. All processed fruit and ice cream will be stored in this freezer. A large cooler will store the ice cream mix and other processed fruit that may need to thaw prior to beings used to make the ice cream. This building will also house a cherry pitter, a fruit sorting table, and a batch freezer which is used to make the ice cream. Additionally, a large three compartment sink is included in the floor plan, which is required by Public Health in order to properly wash, rinse, and sanitize equipment in order to meet compliances for health regulations. Following approval, a representative will come to inspect the building and follow-up with periodic visits to ensure that all health regulations are followed in accordance to set standards.

**Manufacturing capacity and production program**

The ice cream manufacturing industry is formulated with certain appropriate assumption and design to achieve 50% and 65%, 80 %, 100% capacity utilization rate in the first, second and full capacity will be attained in the third year and onwards.

Assumption@ full capacity of working:

Working day per year =300days;

The Capacity = 250L/batch, six batch ice cream per day;

Amount of fruit required annually = 75Kg*6 batch/day*300 working days/annual = 135,000Kg /year and Cream = 250*10%*6*300 = 45,000Kg/year;

Non-fat milk= 250*10%*6*300= 45,000Kg/year;

Sugar = 250*10%*6*300 days = 45,000 kg/year; Corn= 250*4%*6*300 = 18,000 Kg/year;

Additives = 250* 0.3*6*300= 1,350 kg/year; Water = 250*60%*6*300 = 270,000L/year.

Annum Capacity of the ice cream processing unit= 250L/batch*6 batch/day*300 working days/year = 450,000L/year

**Cost of Machinery and Equipment:** Based on their size and material of construction of each piece of ice cream processing equipment's, the purchase cost is estimated (Table 4) in appropriate equipment manufacturing companies, that were considered essential pieces of equipment needed in order to carry out the complete ice cream process. A list of these pieces of equipment,

**Table 1. SWOT Analysis.**

| | Strengths | Weaknesses |
|---|---|---|
| Human Resources | · Education in ice cream production<br>· Experience with product and customers<br>· Ease of communication due to small work force<br>· Prior knowledge of fruit processing | · Intense workload for employees |
| Physical Resources | · Fruit is grown in close proximity to processing facility<br>· Facility located off of a paved road | · Land, buildings and equipment need to be purchased which will come at a high cost |
| | | · Freezer space will be an important part of the facilities but the company's needs may change drastically over time |
| Financial Resources | · Transport costs are still minimal and done for this particular product<br>· Situated in lower tax assessed area | · Initial start-up costs will be large and take a large amount of capital |
| | Opportunities | Threats |
| | · Need for premium ice cream in hotel and convention centers | · Market trend in ice cream has been decreasing [6] |
| | · Contracting product out during the summer season will reduce the effects of market flux. | · Contracts may be difficult to maintain year-round<br>· Seasonal inventory needs to be stored until it is needed.<br>· Currency and raw material<br>· Mode of transportation |

**Table 2. Detailed Project Assumptions at full scale capacity.**

| Parameter | Value Assumed |
|---|---|
| Capacity of the ice cream processing unit | 450,000L /annum ice cream |
| Utilization of capacity | 1st year implementation,50% in 2nd year, 65% in 3rd year 85%, and 4th year onwards 100% |
| Working days | 300 days |
| Working hours per day | 8 hrs. |
| Interest on term and working capital loan | 7.50% |
| Payment period. | Seven years with Three-year grace period is considered. |
| Average sale prices | 5% less than current price |
| Daily production capacity | 6,000L/day |

their respective manufacturers, and price can be seen in table 3.

**Fixed Capital investment estimation:** The required fixed capital investment for ice cream processing industry is estimated from the total purchased equipment cost using the equipment cost ratio method by considering it as solid-fluid processing plant.

**Total Product cost estimation:**

Total Product Cost = Manufacturing Cost + General Expenses;
Manufacturing Cost = Direct Production Cost + Fixed Charges + Plant Overhead Costs
General Expense = Administrative Costs + Distribution and Selling Costs + Interest

**Direct production cost:** Direct cost = Raw materials + utilities + operating labor + Direct supervision +maintenance and repairs + operating supplies + Laboratory charges

**Table 3. Investment Cost Equipment Purchased equipment.**

| S/r No | Type Details of Equipment | Qty | Price USD |
|---|---|---|---|
| 1 | Hot water Generator/Boiler | 1 | 8,000 |
| 2 | Pasteurizer | 1 | 5,000 |
| 3 | Mix Pump | 1 | 3,000 |
| 4 | Filter | 1 | 2,000 |
| 5 | Homogenizer | 1 | 18,000 |
| 6 | Plate Heat Exchanger (PHE) | 1 | 5,000 |
| 7 | Aging Tank | 1 | 2,000 |
| 8 | Flavor Tank | 1 | 2,000 |
| 9 | Continuous Freezer | 1 | 5,000 |
| 10 | Fruit Feeder | 1 | 2,000 |
| 11 | Filling & Packaging | 1 | 5,000 |
| 12 | Hardener | 1 | 3,000 |
| 13 | Cold Room | 1 | 10,000 |
| 14 | Reefer Van | 1 | 5,000 |
| 15 | control panel | 1 | 5,000 |
| 16 | Other Equipment and Accessory other | - | 20,000 |
| | Co | | 100,000 |

Sources: https://www.alibaba.com/

**Table 4. Fixed capital investment estimation/Estimation costs: direct, indirect and total capital investment.**

| Direct cost | | | |
|---|---|---|---|
| **Sr. No** | **Direct cost** | **% Of purchased Cost** | **Purchased cost (US $** |
| 1 | Purchased Equipment | 100 | 100,000 |
| 2 | Purchased Equipment Installation | 20 | 20,000 |
| 3 | Instrumentation and Control | 10 | 10,000 |
| 4 | Electrical Installation | 10 | 10,000 |
| 5 | Building (Including Services) | 22 | 22,000 |
| 6 | Service Facilities | 45 | 45,000 |
| 7 | Piping installation | 16 | 16,000 |
| 8 | Yard Improvements | 10 | 10,000 |
| 9 | Land | 6 | 6,000 |
| Total direct cost | | 239 | 239,000 |
| Indirect cost | | | |
| 10 | Engineering and supervision | 20 | 20,000 |
| 11 | Construction and expense | 25 | 25,000 |
| Total Indirect cost | | 45 | 45,000 |
| Other Costs | | | |
| 12 | Contractor's fee | 17 | 17,000 |
| 13 | Contingency | 15 | 15,000 |
| 14 | Fixed capital investment (FCI)= (direct t+ Indirect + Other) cost | 316 | 316,000 |
| 15 | Working capital investment (WCI) | 34.9 | 35,111 |
| | Total capital investment (TCI) = FCI + WCI | 351.1 | 351,111 |

1USD=40 ETB
NB: Includes cost and freight along with logistics plus workshop machines

NB. Direct supervision and Laboratory charges are not considered

**Main Raw materials cost:** The major raw materials used in production of ice cream are dairy inputs (cream, milk), fruit, mix ingredients/ additives, water. From the material balance the raw materials used during mixing was calculated, in this specific project we follow an estimate for material. Therefore, the annual required raw materials with their assumed prices can be shown in the following Table 5.

**Man power requirement:** The estimated cost of man power of permanent staffs and others causal staffs is calculated from fixed capital investments Cost @ 13% of FCI= 316,000*0.13= $41,080/year. Note: Among employees, Manager, 4-skilled, workers are permanent staffs only and others are causal staffs.

**A. Fixed charges**

Fixed charge includes Depreciation, Local tax 35%, Insurance and rent

**B. Plant overhead costs**

It is about 60% of operating labor
Plant overhead cost = 60% of operating labor = 18,555.25*60%= $11,133.15
Manufacturing cost = Total (direct production +fixed charge + plant overhead) cost= $348,838.64

**1. General expense**

In addition to manufacturing cost, other general expense is involved in any company's operations. These general expenses are including: - Administration cost; about 15% of total product cost, Distribution and selling costs; about 10% of total product cost, Research and development cost; about 2% of total product cost, Financing (interest), about 10% of capital investment.

**Total general expense** = (Administration cost + Distribution and selling costs + Research and development cost+ Financing (interest)) *37% = **$371,104.94*37% = $7,793.20**

**2. Total production cost** = manufacturing cost + general expenses = $371,104.94
One bottle size = 0.25L

Annually plant production capacity @ full operation =450,000L/year

Unit production cost = Total product cost TPC/ annual production capacity = $371,104.94/450,000L/year = $0.82/L
Profit margin=30% of Unit Production Cost = $0.82/L*30%= $0.25/L

**N.B. Assume 1Kg is Equivalent to 1 Litter.**

**Financial evaluation**

**Net income and return on investment**

❖ Assuming Local Gross earn of current price of the ice cream is $5/Kg. However, the price is based on the specification of the ice cream. Based on this planned to price the cost of Our product with 5% lower of the average of current price to $4.75/kg bottle

**Table 5. Direct production cost (variable cost).**

| 1. Raw Materials | | | | |
|---|---|---|---|---|
| **Item** | **Amount per Batch** | **Unit price** | **Price/Batch** | **($/year)** |
| Cream | 25Kg | $3.09 | 77.18 | 138,915 |
| Milk | 25L | $1 | 25 | 45,000 |
| Fruit (Avocado) | 75Kg from | $0.60 | 120 | 43,800 |
| Sugar | 25Kg | $0.60 | 15 | 4,500 |
| Additives | 7.5Kg | $2 | 40 | 14,600 |
| Corn | 10Kg | 0.7 | 7 | 2,100 |
| Water | 150L | 0.06 | 9 | 2,700 |
| Total price | | $8.05 | 293.18 | 251,615 |

**Table 6. Other direct production cost and total direct production cost.**

| Other Variable cost | | |
|---|---|---|
| **No** | **Item Cost /yr.** | **Cost /yr. in USD** |
| 1 | Operating labor (OL) (5-15% of TPC) | 18,555.25 |
| 2 | Direct supervisors and clerical Labor | 15,800 |
| 3 | Utilities (cost of electric, water, Natural gas, O2, etc.) | 18,555.25 |
| 4 | Maintenance and repair (2-10% of FCI) | 15,800 |
| 5 | Laboratory changes (2-10% of FCI) | 15,800 |
| Total direct other production cost | | 84,510.50 |
| Total direct production cost; TDPC=cost (raw material+ Other Variable cost) | | 336,125.50 |

Table 7. Fixed operating costs.

| Sr. No | Item | Approximation | Cost (USD) |
|---|---|---|---|
| | Depreciation | 2 % of FCI | 6320 |
| | Local taxes | 1% of FCI | 3160 |
| | Insurance | 10% 0f FCI | 31,600 |
| | Rent | 8% 0f (land + building) | 22,000 |
| Total fixed operating cost (fixd charges) | | | 63,080 |

Table 8. Cash flow chart considering interest.

| Year | 0 | 2022 | 2023 | 2024 | 2025 | 2026 |
|---|---|---|---|---|---|---|
| **Capacity** | | 50% | 65% | 85% | 100% | 100% |
| **Cash inflow (Sales) (I)** | - | 1,068,750 | 1,389,375 | 1,816,875 | 2,137,500 | 2,137,500 |
| **Cash outflow ( II)** | 351,111 | 214,725.93 | 279,143.70 | 365,034.07 | 429,451.85 | 429,451.85 |
| Direct production cost | | 168,062.75 | 218,481.58 | 285,706.68 | 336,125.50 | 336,125.50 |
| Total Fixed cost | | 34,040 | 44,252 | 57,868 | 68,080 | 68,080 |
| Factory overhead cost | | 5,566.58 | 7,236.55 | 9,463,18 | 11,133.15 | 11,133.15 |
| Total general expense | | 3,896.60 | 5,065,58 | 6,624.22 | 7,793.20 | 7,793.20 |
| Depreciation cost | | 3,160 | 4,108 | 5,372 | 6320 | 6320 |
| **Gross profit (II-I)** | | 854,024.07 | 1,110,231.30 | 1,451,840.93 | 1,708,048.15 | 1,708,048.15 |
| Tax (35%) | | 298,908.42 | 388,580.96 | 508,144.33 | 597,816.85 | 597,816.85 |
| Net Profit | | 555,115.65 | 721,650,35 | 943,696.60 | 1,110,231.30 | 1,110,231.30 |
| Cash flow | | 561,275.65 | 725,758.35 | 949,068.60 | 1,116,551.30 | 1,116,551.30 |
| Discount factor=(1+IRR)-n | | 0.89 | 0.8 | 0.71 | 0.64 | 0.57 |
| PV | -351,111 | 2,154,990.95 | 2,519,788.08 | 2,916,888.28 | 3,101,392.83 | 2,762,177.99 |

Note: Cash flow= Net income +depreciation, Present Value= cash flow* discount factor (If IRR=0.12), Return on Investment (ROI) = annual profit*100/Total Capital Investment, Payback period (PBP) = Total capital investment/Net Profit per year + Average depreciation per year, Break Even point: Total product cost = Total sales Income, Total Sales Income= Direct Production cost + fixed charge + Plant Overhead cost+ General Expenses, Net present Value = Summation of PV-TCI=1.03X107.

ROI = [(1,110,231.30) / (351,111)] *100 = $316.21

PBP = (351,111)/ (1,110,231.30+ 6320) = ~ 4Months

& similarly 5% reduction sale for local market.

❖ Locally total selling price (revenue) = 450,000L/year*4.75$/L=$2,137,500

❖ Gross profit = Locally total selling price (revenue) - total production cost = $2,137,500 - $371,104.94 =$1,766,395.06

❖ Income tax on gross profit (35%) = $1,766,395.06*35%= $618,238.27

❖ Net income (profit) = $2,137,500 - $618,238.27 = 1,519,261.73

❖ % profit = net income /Total production cost = $1,519,261.73/$371,104.94*100= 409%

**Cash Flow Return (DCFR):** The discount flow rate of return is the return obtained from an investment in which all investment and cash flows are discounted. It is determined by setting the NPV equation equal to zero and solving for the discount rate that satisfies relation. Consider the plant capacity starting with 50% capacity at the first year and 650% capacity in the second year, third year, with 85% capacity and 100% capacity for the remaining project life. Detail manipulation and the project life summary of economic data detail is given in the following cash flow table 9 below.

## Conclusion and Recommendation

The feasibility study of the net present value is positive and the payback periods less than one year the project is acceptable and viable for implementation. Those, the payback periods of approximately 4months apparently minimize any risk in regaining the initial investment. The most critical determinants of the viability of the project are NPV which in this case are adequate to avoid any doubts about the project's viability.

Since, the study confirmed the feasibility and workability of the business idea. Hence, ice cream processing is a business opportunity that is yet to be fully exploited. Therefore, as a recommendation for those who have a potential of investing, if they run this business idea, they can succeed.

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