# EVALUATING SUSTAINABLE BUSINESS MODELS

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**ABSTRACT**

During the last decade, companies felt an unprecedented pressure to broaden the accountability beyond a purely financial performance. The principle of sustainable development inspired an entire generation of scholars and led to a multitude of publications regarding sustainability. The concept of business or corporate sustainability has therefore grown in recognition and importance.

Nevertheless, it remains difficult for organizations to evaluate their sustainability regarding if they "meet the needs of the present without compromising the ability of future generations to meet their own needs." [1]

Since this broad definition provides little guidance and it is very difficult to apply, a sustainability criteria designed for businesses and a set of methods to evaluate corporate sustainability accordingly, were proposed.

A new business model developed in Portugal for a social coop project was analyzed. The first approach was to map the cooperative's business model through the triple layer model canvas, which allowed a broad perspective of the actors in the project and the potential economic, environmental and social impacts of the project for each. Although not quantitative, it served as a framework for the subsequent analyses: an economic evaluation with internal focus; a social assessment from a stakeholder's perspective; an environmental analysis from a lifecycle perspective and an overall assessment with the three dimensions evaluated simultaneously.

**Keywords:** Life Cycle Assessment, Social Return on Investment, Social Life Cycle Assessment, Net Present Value

## 1 INTRODUCTION

Although climate change, water scarcity, pollution, food safety, may be the most visible issues, there are others rising [2].

Around the world, political leaders, scientific experts, and consumers are demanding companies to evolve in a sustainable way.

Consumers are asking themselves questions about the economic, environmental and social circumstances under which a product is made [3]. That kind of social scrutiny is forcing corporations to adopt not only stricter environmental regulations but a greater social responsibility [4].

The principle of sustainable development inspired an entire generation of scholars and led to a multitude of publications regarding sustainability. The concept of business or corporate sustainability has therefore grown in recognition and importance [5]. Nevertheless, it remains difficult for organizations to evaluate their sustainability regarding if they "meet the needs of the present without compromising the ability of future generations to meet their own needs." [1].

Every single business creates negative and positive impacts whether social, environmental or economic. Within the corporate world, they are sometimes mentioned to as the triple bottom line (3BL). This concept was coined by John Elkington back in 1994 and it is gathering momentum since then. It is a departure from the traditional "bottom line," which evaluates all efforts regarding their short-term effect on "profit" or "loss". The triple bottom line is seen as the micro-economy definition of the broader sustainability definition created by World Commission on Environment and Development [1].

Far from reuniting consensus, the tree bottom lines are currently being extensively debated, particularly for what concerns the impacts that should be allocated in social and economic spheres [6].

In the literature, there are two approaches to address economic sustainability. The first one focus on how organizations stay in business and approaches the issue from the inside. The second looks at the economic impacts an organization has on society – the outside or stakeholder view [7].

Today and although there is a rapidly growing literature on sustainability, there are almost no examples regarding the integration of the triple bottom line in business model. There are virtually no tools to support companies to implement a sustainable business model [8]. Recently, driven by an increasing of stakeholder demands on sustainability issues, some experts are arguing about the need of rethink all concept of business model to move to a more sustainable one [8].

The time when scientific community thought that sustainability and financial performance could not be compatible is now gone. Scientists start to believe that environmentally-conscious and ecologically-friendly strategies can, indeed, lead to a superior financial performance [9][10][11].

The growing enthusiasm around a pro-sustainability image and sustainability itself is pushing the scientific community to develop new ways of reporting and evaluating the triple bottom line. Notwithstanding, the existing frameworks are either to "high level," presenting just some principles about how a sustainability assessment should be done (without

presenting any methods) or to specific and just applicable to a very particular type of organization.

The proposed methodology is a beginning towards tackling the above mentioned critical issues. In this sense, this work presented a novel approach of sustainability assessment, proposing a sustainability criteria designed for businesses and a set of methods (applicable to any kind of business) to evaluate an organization's sustainability accordingly.

This study analyses the economic, environmental and social impact of this project, called Fruta Feia and determines the success factors of this case study. The first part of this work presents the project and the business model sustaining it through Triple Layer Business Model Canvas (TLBMC). The economic sustainability is then assessed by an investment appraisal of the project.

The environmental assessment is presented using the Life Cycle Assessment (LCA) methodology. One of the firsts published applications of LCA was made in 1969 by Coca-Cola, with the objective of evaluating the resource consumption as long as the emissions related to beverage containers[12]. Nowadays, 47 years after the Coca-Cola Study, LCA methodology is still a young discipline being researched and developed [13]. While improvements continue to be made, international and draft standards of the ISO 14000 series are, in general, acknowledged as providing a consensus framework for LCA [14]

The social impact of the project is shown by analysing the project through the Social-Life Cycle Assessment (S-LCA) methodology. Social impacts evaluation is still a very young discipline. In fact, the United Nations Environmental Programme (UNEP), the Society for Environmental Toxicology and Chemistry (SETAC) and the Life Cycle Initiative have recently published the first official set of "Guidelines for Social Life Cycle Assessment of Products" [15].

Finally, the project is also assessed through the Social Return on Investment (SROI) method, which includes the three dimensions of analysis by monetizing the economic, environmental and social value created. With these analyses, some conclusions are drawn regarding the key factors that contributed for the success and growth of the project, along with the potential of this type of projects to reduce food waste in a meaningful scale. To guarantee the transparency and ensure the replicability all the procedures of the methods applied are explained.

## 2 MEANS AND METHODS

In this section, the means and methods proposed to assess the sustainability of Fruta Feia business model are presented. The case study is described regarding the goals of the project and functioning of the business model.

To guarantee the transparency and ensure the replicability all the procedures of the methods applied are explained in detail.

### 2.1 Fruta Feia Case Study

The requirements imposed by large conventional retailers for fruit and vegetables, such as size, color, and shape are forcing farmers to have restricted control and selection policies and, only the products that are in full accordance with the imposed requirements are sent to the market and then to the end consumer.

Fruta Feia is a non-profit Cooperative that arises from the need to overturn the standardization trends regarding fruit and vegetables [16].

In order to accomplish that goal, Fruta Feia purchases the fruit and vegetables that don't meet the requirements imposed by conventional retailers directly from a network of farmers. The "ugly" products are then transported to a delivery point and installed in boxes (with the help of volunteers) and then sold to the Cooperative's associates.

This prevents the unnecessary use of resources on their production, such as water, land, energy and working hours. By changing consumption patterns, this project intends that in the future all the fruits and vegetables are marketed equally, regardless of their size, colour and shape. Until now, the project has saved in Lisbon and Oporto around 320 tons of fruits and vegetables from being wasted.

Alongside this local impact, the project foster the awareness of the population to the food waste problem, as well as to the fact that "ugly food" can be of good quality. This enables people to have access to food that is cheaper and produced locally. The farmers earn extra money by selling products that, otherwise, would not be marketed. This is the key novelty of Fruta Feia - not only avoids waste, as other projects aim, but also creates value to "ugly" products.

### 2.2 Triple Layer Business Model Canvas (TLBMC)

The aim of a business model is to show how a business works and how value is created. A sustainable business seeks not only economic value but also social and environmental values for a much broader group of stakeholders. A sustainable business model can be defined as one that generates competitive advantage thanks to greater customer value while contributing to sustainable development of the organization and society [17].

TLBMC's layered format helps users to better understand and represent the interconnections and relationships between organizations' current actions and its economic, environmental and social impacts. Furthermore, it allows economic, environmental and social value to be explored horizontally within their own layer and in relationship to each other through the vertical integration of these layers together. These characteristics make it ideally suited to support each one of the analysis.

### 2.3 Economic Evaluation – Investment appraisal of the project

The first step for businesses, who are serious about social responsibility, is to stay in business [18]

Fruta Feia is a social-driven cooperative. Nevertheless, the economic dimension of sustainability is one of the milestones of the project since without this dimension safeguarded the project cannot continue to make a difference in the other bottom lines.

The economic evaluation aims not only to test the current practices but also to help decision making (whether or not to create for one more delivery point for ex.).

The economic sustainability was evaluated based on widely established discounted cash flow methods. These methods take into consideration the time value of the money (the idea that a future euro has less value than a presently held on.

Both Net Present Value (NPV) and Internal Rate of Return evaluate economic profitability based on cash flows and investment required. A project's NPV equals the present value of net cash inflows that the project is expected to generate, minus the initial project's investment. Internal rate of return is nothing but the discount rate that makes NVP equal to zero. The profitability is assured when the NPV for the period in the analysis is greater than zero [19].

### 2.4 Environmental evaluation - Life Cycle Assessment (LCA)

LCA can be defined as a tool to assess potential environmental impacts and resources consumed throughout the product's life cycle, that is, from raw material acquisition to waste management [13].

There are several methods for the impact assessment stage compatible with ISO requirements, and therefore most experts prefer to select a published method instead of developing a new one [19].

The method chosen is divided into four steps: Goal and Scope Definition; Life Cycle Inventory Analysis (LCI); Life Cycle Impact Assessment (LCIA); Interpretation.

### 2.5 Social Evaluation - Social Life Cycle Assessment (S-LCA)

These Guidelines are the standard framework to which Social Life Cycle Assessment (S-LCA) researchers will seek to harmonize and standardize the S-LCA process. Like LCA, S-LCA is based on four steps of analysis: goal definition, scope definition, inventory analysis and impact assessment.

One important difference between LCA and S-LCA is the indicators definition and quantification. Given the developing phase of the method and the subjectivity inherent to the social impacts, it is up to the stakeholders to determine the most appropriate indicators. Also, regarding the impact assessment phase, the Guidelines for S-LCA do not discuss normalization or valuation of impacts, as assessment methodologies are under development and S-LCA is an open field for future research.

Given the limitations nowadays in the S-LCA standardization, in this study an approach proposed by Ciroth and Franze (2011) was followed, with a rating system as the assessment method for the impact categories for each subcategory of each stakeholder.

### 2.6 Social Return on Investment (SROI)

The method chosen to assess Fruta Feia overall sustainability addresses the paradox between accountability and learning, by placing the perspectives of the different stakeholders at the center of the valuation process. Titled Social Return of Investment, it is a methodical way of incorporating social, environmental and economic impacs into decision-making processes by mapping and revealing the economic value (€) of social and environmental outcomes This enables the calculation of a benefit cost ratio. An SROI of 2:1 means that an investment of 1 euro delivers 2 euros of Social Value [20]. When it comes to SROI methodology social value encompasses economic, environmental and social value.

SROI can help investors to select more efficiently the investments that are aligned with their objectives.

By using the most worldwide known metric (money), this method induces tranparency and makes it easer to align and integrate the results with financial management siystems. [21].

## 3 APPLICATION OF THE METHODS AND MAIN RESULTS

In this chapter are presented the results obtained applying each method proposed to assess the sustainability of the case study.

### 3.1 Triple Layered Business Model Canvas

The Fruta Feia model is based on a replication scheme, taking advantage of a fixed structure created for each city (transportation van, office, farmer's network, volunteers and staff) and a shared website. Each city has several delivery points geographically dispersed, that work alternately depending on the day of the week. For each delivery point, the products are transported from local producers directly to the consumer on the same day. Beyond local and seasonal the cooperative is committed to delivering the "ugly" fruit and vegetables with a low-profit margin. Therefore, the economic value proposition is local, seasonal fruit and vegetables below the market price (as highlighted in Figure 1)

As it was previously stated, Fruta Feia buys the fruit and vegetables that do not meet the requirements imposed by the supermarkets from the farmers. The staff is in charge of the transportation and once the arrival to the delivery point, a group of volunteers help with the distribution of the products in baskets. The space for the delivery, different in each delivery point, is required for only an afternoon per week and is provided by associations due to the social aspect of the project. Furthermore, the high number of associates of the project promotes the local, cultural or sports associations that offer the space. Therefore, the farmers, the volunteers, and local associations have been pinpointed as partners in TLBMC's economic layer.

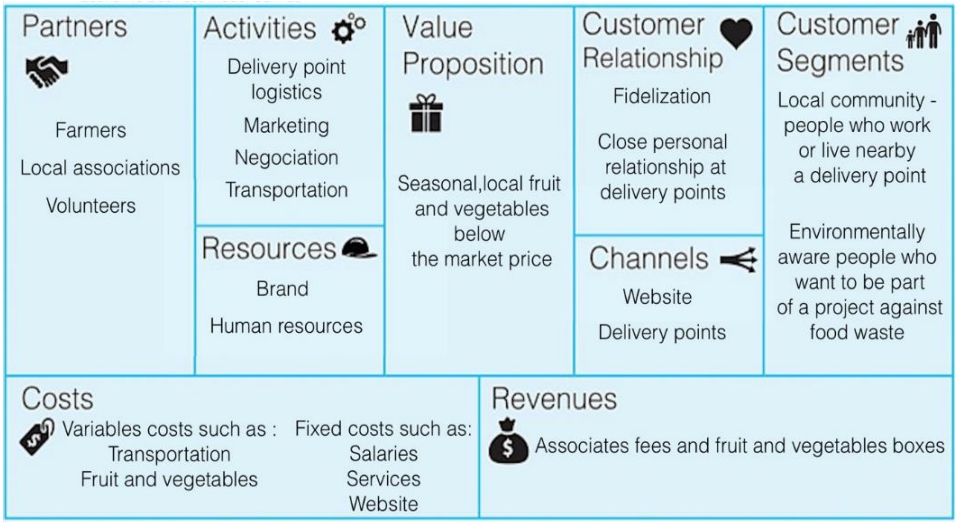


*Figure 1 Triple Layered Business Model Canvas Economic Layer (Fruta Feia)*

The baskets are then sold to the associates of the project who pick their baskets weekly. These are environmental aware people that want to be part of a project against food waste. Typically, people that live or work nearby a delivery point. Pinpointed in the economic layer as customer segments.

Fruta Feia stimulates a close-knit environment between volunteers, staff, and associates in the delivery point promoting a very personal relationship between staff, volunteers, and associates.

Additionally, being a cooperative, it fosters the feeling of belonging, and consequently customer loyalty. These have both been considered the main characteristics of customer relationships.

The associates pay the boxes they bought, plus an annual fee to be part of the cooperative (other measure meant to promote customer loyalty). The sold boxes and associates' fees compose the two revenue streams highlighted as revenues.

The associates use the website not only to check the next week box composition but also to give feedback or even cancel the box. By default, the cooperative counts with every associate, so, it is up to them to cancel the box in advance (stimulating responsibility and loyalty once again). Thus, the website and the delivery points are the key Fruta Feia channels.

The transportation of fruit and vegetables, the delivery point logistics (activities between the products arrival and delivery in each delivery point), the negotiation with the farmers in (ensure that the prices of the Fruit and Vegetables are fair to all the parts involved so) and marketing are the cooperative's main activities. Marketing was until now the least important activity since the intense media coverage allowed these costs to remain negligible.

Fruta Feia costs go much beyond marketing. The coop's main variable Costs are the costs directly related to the acquisition and transportation of fruit and vegetables. When it comes to fixed costs, there are the salaries, website expenses, and other services like a certified accountant (Portuguese legal obligation).

Being the first of its kind, Fruta Feia is now an established cooperative. Their name has grown in recognition and the image and design developed in an early development phase, are now part of a powerful brand. That, along with highly motivated staff, eager to be part of the project and willing and capable of very different tasks (from office work and logistics to physical work during the distribution) are now the cooperative main resources.

The environmental layer (Figure 2) of TLBMC reflects the full range of environmental impacts that can be assigned to Fruta Feia project from a pure lifecycle perspective.

Just like functional unit in the life cycle assessment methodology, the functional value is intended to clarify what is being examined. The Functional Value has been defined as the amount of fruit and vegetables delivered once a week multiplied by the number of associates over the period of one year.

Just like the activities block from the economic canvas, the Production block is seen as activities that are used.

As it was previously stated, Fruta Feia ensures the access to the defined functional value through delivery point logistics, pinpointed as Distribution in the environmental layer. When the distribution ends, the use phase begins.

The Use Phase focuses on the impact of the clients after acquiring the product or service. In this case, the impacts that can be allocated to the defined functional value is the possible use of transportation by the customer.

End-of-life starts when the use phase finishes. The project has a positive impact of avoiding the food waste, and therefore a scenario of avoiding food on landfill was considered in End-of-Life.

Also, necessary for the functional value, but not performed by the coop, is the production of the fruit and vegetables. Therefore, *farmers* have been highlighted in the Supplies and Out-sourcing block.

Fruta Feia prevents that ugly fruits from going to landfill and consequently root, the food waste avoided and the climate change mitigation benefits associated have been highlighted as Environmental Benefits. However, there is *a potential rebound effect* on the farmers regarding the increase of offer in the market (highlighted Environmental impacts). For the same demand, more fruits and vegetables are available, and the reduction of waste does not mean the reduction of production.

As it was highlighted before, the products are distributed in boxes. It is up to each associate and volunteer to put the respective products in a plastic bag to carry home. Both *bags* and *wooden boxes* are offered to the associates in the first week and reused ever since, even so, they have been pinpointed as required Materials in the environmental layer.

As a social-oriented organization, for which creating social value is one of the milestones, the cooperative plays an important role when it comes to social impact. There are several actors in the local community affected positively by the project.

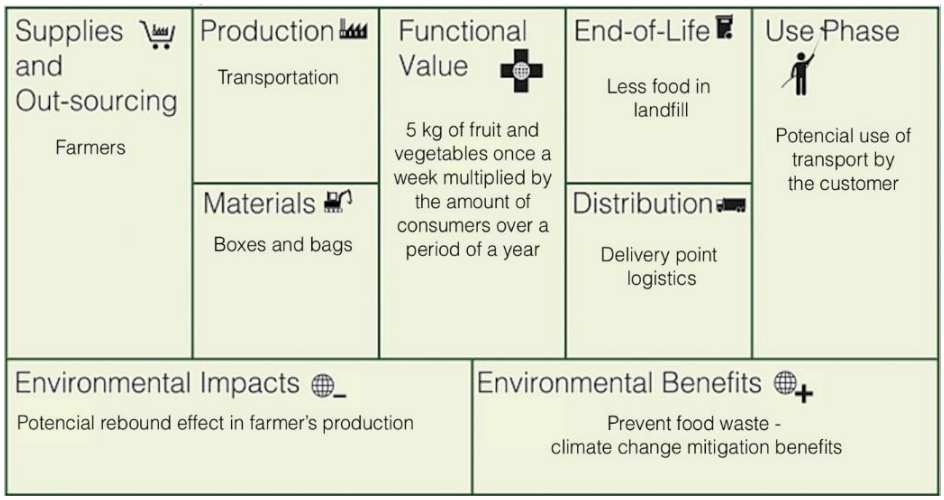


*Figure 2 Triple Layered Business Model Canvas Environmental Layer (Fruta Feia)*

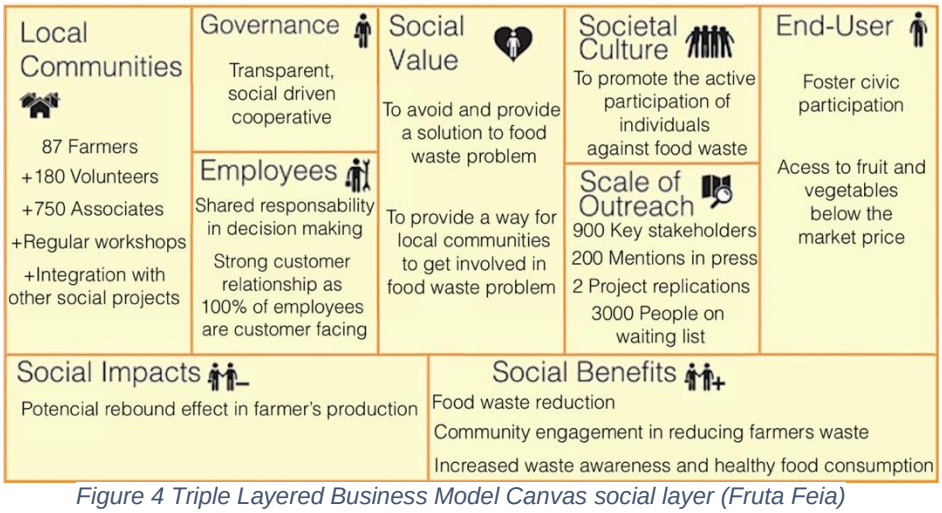


*Figure 4 Triple Layered Business Model Canvas social layer (Fruta Feia)*

While economic relationships are built with business partners, there are social relationships built with Local Communities (as pinpointed in Figure 4):

*87 farmers*, regularly, drain their "ugly products" trough Fruta Feia;

More than *180 volunteers* not only feel involved in a social project but also receive a free box each week.

More than *750 associates* gain access to fresh, local fruit below the market price and at the same time, they are able to fight food waste and support local farmers.

Other Social projects like RE-FOOD that benefit from the cooperative's activity (If by chance, the associate does not pick the box, the fruit and vegetables not delivered are offered to RE-FOOD, a charitable organization also fighting food waste)

The main Social Benefits are therefore the food waste reduction, the community engagement in reducing the farmers waste, the increase in awareness of the waste problem and the increase of fruits and vegetables consumption. Being legally a non-profit organization, the cooperative follows a transparent and social driven Governance and sessions are held with the partners for important decisions.

The Employees also take part of these sessions and have shared responsibility in the decision-making process. Additionally, since all the staff is 100% customer facing there is a strong relationship between them and the customers. They need to establish a strong relationship with the associates and assure that the social driver behind the creation of the project is not lost. With that in mind, it promotes the engagement of individuals against food waste and their active participation (Social Culture).

The Scale of Outreach of the project is hard to quantify, as several replications took place in other countries, with the visit of these associations or individuals to understand the operational functioning of the coop. It has numerous key stakeholders (farmers+volunteers+staff+associates), an intense media coverage (more than 200 mentions in national and international press) and more than 3000 people in waiting list waiting to become associates.

### 3.2 Capital Budgeting

The investment appraisal methods have been computed to three different scenarios (one, two and three delegations) considering a 5-year time frame. Given the social nature of the project, the low fixed structure and investments, and the successful test of the pilot project in Lisbon, a low discount rate was used. The return rate used was the 3.5%, a value recommended in HM Treasury Green Book to social projects. In order to facilitate the analysis, the cash flows have been aggregated in an annual basis.

As shown in Table 1, the payback period depends on the number of delivery points in one region. For only one delivery point, the accumulated present value considering the investments is only positive in the third year. With 3 delivery points, the discounted payback period is two years.

In the fifth year, the NPV is positive for all scenarios. As it can be seen the Net Present value is negative only in the first year for any number of delegations. Since any positive NPV indicates that the project delivers more than the normal threshold rate of return, all the alternatives are economically sustainable considering two, three, four and a five-year time frame. As it was expected the, either NPV or IRR increased with the increase of the number of delivery points. This can be easily explained, given that no differences were considered between the delivery points when it comes to revenues and costs and there are costs independent of the number of delivery points as the investment made in the van and computer for example.

*Table 1 Investment appraisal results*

| Years | No. of delivery points | Revenues [€] | Profit Margin [€] | NPV [€] | IRR [-] |
|---|---|---|---|---|---|
| 1 | 1 | 42480 | 74 | -12440 | -0.99 |
| | 2 | 84960 | 5256 | -7434 | -0.58 |
| | 3 | 127440 | 11432 | -1466 | -0.09 |
| 2 | 1 | 51160 | 7702 | -5220 | -0.21 |
| | 2 | 102320 | 18727 | 10048 | 0.45 |
| | 3 | 153480 | 30186 | 26713 | 1.08 |
| 3 | 1 | 51160 | 7702 | 1697 | 0.09 |
| | 2 | 102320 | 18727 | 26939 | 0.76 |
| | 3 | 153480 | 30186 | 53939 | 1.37 |
| 4 | 1 | 51160 | 7702 | 8410 | 0.23 |
| | 2 | 102320 | 18727 | 43258 | 0.87 |
| | 3 | 153480 | 30186 | 80244 | 1.46 |
| 5 | 1 | 51160 | 7702 | 14895 | 0.31 |
| | 2 | 102320 | 18727 | 59026 | 0.92 |
| | 3 | 153480 | 30186 | 105660 | 1.49 |

Fruta Feia cost structure (Table 2) explains the sustainability of the business model. Despite the low-profit margin of the commercialized products, the amortizations regarding the investment in fixed assets only account for 10% of the fixed costs, and therefore 5% of the total costs. This allows for the independence of the project growth from the investment, with the staff salaries (one of the two major cost drivers) added to the project according to the number of delivery points.

*Table 2 Fruta Feia Cost Structure (5º Year and 1 Delegation)*

| Cost type | Cost driver | Cost |
|---|---|---|
| Variable Costs | Transport | 6% |
| | Fruits and vegetables | 94% |
| Total Variable | | 52% |
| Fixed Costs | Salaries | 80% |
| | Services | 7% |
| | Webpage | 1% |
| | Other fixed costs | 2% |
| | Depreciation | 10% |
| Total Fixed | | 48% |

### 3.3 Life Cycle Assessment

This Life Cycle Assessment is intended to assess the environmental sustainability of Fruta Feia. As it was defined in the environmental criteria an environmentally sustainable organization is an organization who has a positive impact in the environment. With this in mind, two scenarios have been defined and can be observed in Figure 5:

The **scenario 1**, where the fruit and vegetables that do not meet the requirements imposed by the supermarkets go directly to landfill;

The **scenario 2** where the "ugly" products are bought and distributed by Fruta Feia;

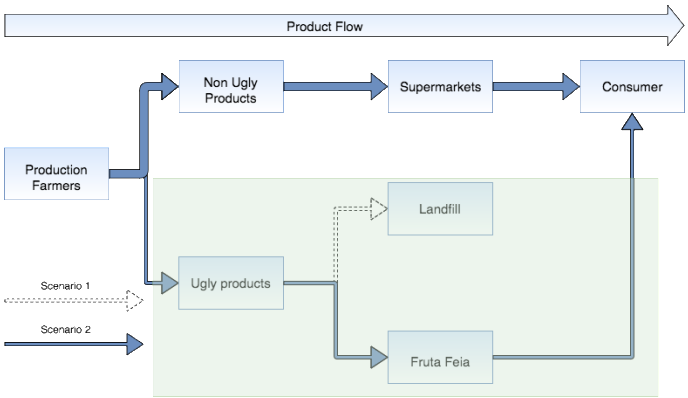


*Figure 5 LCA Scenarios*

Therefore, this LCA is focused on the full life cycle of the fruit and vegetables from production to end-of-life.

The difference between the scenarios is that in situation 1 the "ugly" products go to Landfill and are condemned to rot and in the situation 2 Fruta Feia deliver them to the final consumer.

The functional unit (FU) was defined as 1 kg of fruit and vegetables at the point of sale. Data with the quantities of each product sold during one year were provided by the cooperative and allowed the assessment of the average constitution of the functional unit

Due to lack of data some fruit and vegetables were gathered in groups, for example, sweet potatoes, for calculation effects, were considered just regular potatoes. These assumptions were discussed with the farmers in order to understand if the resources regarding land use, water and fertilizers were equivalent.

Regarding the bags and boxes, due to the small amount and low technological intensity to produce these products, only the raw materials were accounted for. Regarding the transportation, it was assumed the maximum distance per delivery, 160 km, and that in half the distance the van is empty. The production impacts of the van have been disregarded.

Some key pieces of information about the supply chain like crop transportation distance were extrapolated out of information from the first years of activity and referent to Lisbon. Some generic data was used in Simnaproo, however, it should be noted the farming practises may differ beetween regions.

The method selected to calculate the environmental impacts was "ReCiPe". This method is one of the most recent and sophisticated lyfe cycle impact assessment methods. The method used are the recommended by the European Commission to ensure quality and consistency of life cycle data

To identify the environmental impacts of each one of the scenarios considered, a mid-point analysis, followed by a normalization of each one of the 18 categories was computed. Figure 6 shows (in orange) the results with Fruta Feia in the system and (in blue) the results without Fruta Feia in the system.

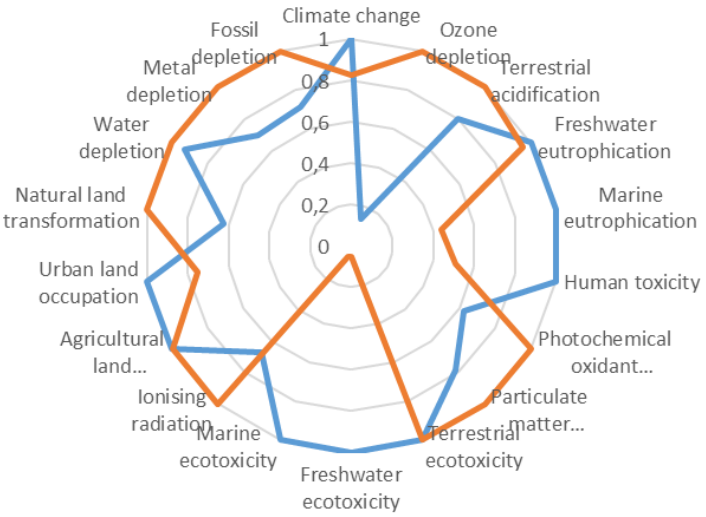


*Figure 6 Midpoint Results*

A closer look to Figure 5 shows that with Fruta Feia in the system there are fewer impacts in nine out of the 18 categories. The climate change midpoint indicator shows that, with Fruta Feia in the system, for each kg of the defined functional value there is 0.14kg less of Co2eq emissions

Figure 7 shows the endpoint analysis carried for the entire life cycles of both scenarios regarding the endpoint categories human health, ecosystems and depletion of resources. As it was expected, since climate change indicator play a major role in endpoint analysis the scenario with Fruta Feia in the system is less harmfull to the environment. However, regarding depletion of resources, the best scenario where the fruit and vegetables that do not meet the requirements imposed by the supermarkets go directly to landfill.

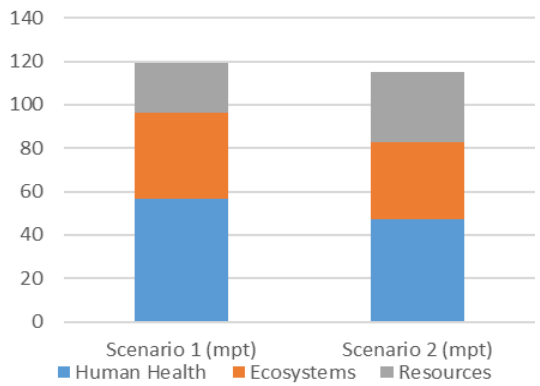


*Figure 7 Endpoint Results*

### 3.4 Social Life Cycle Assessment

This S-LCA is based on the Guidelines for Social Life Cycle Assessment of Products proposed by the United Nations Environment Program in collaboration with Society of Environmental Toxicology and Chemistry.

All the relevant stakeholder categories were identified and subcategories were chosen. For instance, regarding the value chain actors the supplier relationships, promoting social responsibility and fair competition were considered as determinant aspects. The subcategories and indicators were selected based on the proposed indicators proposed by the UNEP/SETAC guidelines. Some, such as child labor and forced labor, were removed due to its inexistence. The impact categories considered for the social assessment are also based on the UNEP/SETAC guidelines for S-LCA

They are as follows: Working conditions (WC),Health and safety (HS), Human rights (HR), Socio-economic repercussions (SER), Governance (G). The category Indigenous rights including cultural heritage (IR) was not considered due to the context of the project (Portugal).

The assessment is performed in two phases. The first one assesses the performance (PA) of the project respectively based on the status of the indicators taking the performance of the project in relation to the situation in the country/region into account. The second phase assesses the impacts (IA) of the project behaviour with regard to the selected impact categories. Each subcategory is assessed twice with a colour system related with a specific factor and grades ranging from very good performance (1) to very poor performance (6) and positive impacts (1) to very negative impacts (6). The factors of all subcategories are summed up for every process and the resulting amounts for the project performance and for the impacts are divided by the number of subcategories. The results are presented in Table 3

As illustrated in Table 3, this social-driven project, is very positive in several areas of the social evaluation. The weaker point of the project regards the working time required for the staff, as longer hours of work are required in the delivery days, two days per week for each worker.

The stronger aspect is the community engagement and the relations with the value chain actors, in this case, the farmers, which are relevant beneficiaries of the project.

*Table 3 Social Life Cycle Assessment Results*

| Stakeholders | Subcategories | PA | WC | HS | HR | SER | G | IA |
|---|---|---|---|---|---|---|---|---|
| Workers | Fair salary | 1 | ✓ | (✓) | (✓) | ✓ | (✓) | 2 |
| | Working time | 4 | ✓ | ✓ | ✓ | ✓ | (✓) | 4 |
| | Discrimination | 1 | ✓ | (✓) | ✓ | (✓) | - | 2 |
| | Health and safety | 2 | ✓ | ✓ | (✓) | (✓) | - | 2 |
| | Social benefits/ security | 1 | ✓ | ✓ | ✓ | ✓ | - | 1 |
| | **Amount** | 3 | | | | | | 3 |
| Local community | Access to immaterial resources | 1 | - | (✓) | (✓) | (✓) | ✓ | 2 |
| | Local employment | 1 | (✓) | (✓) | (✓) | ✓ | ✓ | 1 |
| | Community engagement | 1 | - | - | (✓) | ✓ | ✓ | 1 |
| | **Amount** | 1 | | | | | | 1 |
| Society | Public commitments to sustainable issues | 1 | (✓) | - | - | ✓ | ✓ | 1 |
| | Contribution to economic development | 1 | - | (✓) | - | ✓ | ✓ | 2 |
| | **Amount** | 1 | | | | | | 2 |
| Value chain actors | Fair competition | 1 | ✓ | - | (✓) | ✓ | ✓ | 2 |
| | Promoting social responsibility | 1 | - | - | (✓) | ✓ | ✓ | 1 |
| | Supplier relationships | 1 | ✓ | - | (✓) | ✓ | ✓ | 1 |
| | Volunteers relationships | 1 | (✓) | ✓ | (✓) | ✓ | ✓ | 1 |
| | **Amount** | 1 | | | | | | 1 |
| Consumers | Health and safety | 2 | - | ✓ | (✓) | - | - | 2 |
| | Feedback mechanism | 1 | - | ✓ | (✓) | (✓) | (✓) | 2 |
| | Transparency | 1 | - | (✓) | - | (✓) | ✓ | 1 |
| | **Amount** | 1 | | | | | | 2 |

Legend: - no impacts; ✓ strong relationship between subcategory and impact category; (✓) weak relationship between subcategory and impact category.

| Performance assessment | Colour | Impact assessment |
|---|---|---|
| Very good performance | 1 | Positive effect |
| Good performance | 2 | Lightly positive effect |
| Satisfactory performance | 3 | Indifferent effect |
| Inadequate performance | 4 | Lightly negative effect |
| Poor performance | 5 | Negative effect |
| Very poor performance | 6 | Very negative effect |

### 3.5 Social Return on Investment

Following the SROI methodology, the scope and identification of the key stakeholders were established and is presented in . Along with their identification is also the reasons for the exclusion of some actors in the project. “The Environment” was created as a forth category for public goods that cannot be assigned to the other Stakeholders. These goods are related essentially with climate change mitigation benefits.

*Table 4 Key Stakeholders and reason for inclusion*

| Key Stakeholders | Reason for inclusion |
|---|---|
| “The Environment" | The environment is one of the key beneficiaries of the project given that Fruta Feia is avoiding products decomposition. |
| Farmers | Farmers network is the main reason for the project. Farmers drain fruit and vegetables that, due to aesthetic reasons, cannot be sold to big retailers |
| Partners | Partners are the ones that buy and consume the fruit and vegetables, without them it is impossible to run the activity. |
| Volunteers | Volunteers are an important part of the cooperative since they provide their time to arrange the fruit boxes. |

The phase of evidencing outcomes was developed through group discussions to identify the project outcomes and generate financial proxy in order to calculate the value of the benefits. This was achieved by discussing the value of benefits described in comparison to other economic goods and services available in the local economy. The values were based on information provided from project. Additionally, key informant interviews were held with Fruta Feia staff, farmers, and volunteers. Finally, a survey was carried with 160 key stakeholders which encompassed 132 partners, 20 farmers, and 8 volunteers. The survey incorporated numerous open-ended questions that could record a miscellaneous of potential responses which emphasized that are some outcomes that are particularly valued across the community.

In order to determine how much value has each benefit, some financial proxies were created. Farmers have an extra income (they wouldn’t sell the products otherwise) and less current assets. Usually, the big retailors pay with a delay of 3 months, and one of the core benefits highlighted by the farmers in the survey is the fact that the coop pay on-time. The financial proxy used (extra three months of revenue in first year) takes into consideration decrease in the farmers’ investment in current assets. As the proxies show the worth of the outcomes in monetary terms, for products that are tradable the market price can be used [22] For this, data collected from supermarkets in the same local economic zone during three months allowed to estimate the average market price of the products contained in a regular box.

Since volunteers earn a free box, each time they help, the financial proxy used was the market value of the box. Following the same line of thought the money saved by partners can be calculated using difference between the market value of a fruit and vegetables box and the money they actually pay for it.

Finally, it was considered that the benefits to the environment can be assessed by calculating the difference between the quantities of kg C02eq avoided according to the LCA developed in this study. Although there is an abundance of models trying to determinate the social cost of on metric ton of $CO_2$, in this analyses was used an estimate provided by the Interagency Working Group on Social Cost of Carbon from United States Government [2015] , more specifically the average SCC from three integrated assessment models (IAMs), at discount rate of 2.5. The value used per ton (52.7€) was calculated taking into consideration the variation of the Carbon social cost between 2015 and 2020 [23].

Finally, the present value of all the inputs and benefits were calculated with 3.5% rate in order to maintain the coherency of the study. With all the material impacts properly represented, the present values of the benefits were divided by the present value of the project inputs. The results, presented in Table 5, show that the SROI value is always higher than ones, meaning that for every 1€ invested on the project there is more than 1€ of social value generation. The outcomes causing the social value are the partners’ savings buying fruit and vegetables, the farmer’s extra income, the free boxes for volunteers and the climate change mitigation.

*Table 5 Social Return on Investment Results*

| SROI | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 |
|---|---|---|---|---|---|
| 1 delivery point | 1,11 | 1,36 | 1,45 | 1,5 | 1,53 |
| 2 delivery point | 1,32 | 1,52 | 1,59 | 1,62 | 1,65 |
| 3 delivery point | 1,41 | 1,59 | 1,65 | 1,68 | 1,69 |

## 4 DISCUSSION AND KEY SUCCESS FACTORS

The growing enthusiasm around a pro-sustainability image and sustainability itself is pushing the scientific community to develop new ways of reporting and evaluating the triple bottom line.

Notwithstanding, the existing frameworks are either to “high level,” presenting just some principles about how a sustainability assessment should be done (without presenting any methods) or to specific and just applicable to a very particular type of organization.

Knowing that more informed decisions lead to better results in the future, the objective of this thesis is to propose a framework able to help organizations to evaluate their business models regarding the three bottom lines.

The proposed methodology presented in this study is a beginning towards tackling the above mentioned critical issues. In this sense, this work presented a novel approach of sustainability assessment, proposing a sustainability criteria designed for businesses and a set of methods (applicable to any kind of business) to evaluate an organization’s sustainability accordingly.

To assess the economic sustainability a widely established investment appraisal method is proposed. Titled Net Present Value (NPV) this method assesses the profitability of a project based on the operational cash flows and investments required. The profitability is assured when the NPV within the time period analysed is greater than zero.

The Life Cycle Assessment was the method chosen to perform the environmental evaluation. The LCA methodology is nowadays a structured method to quantify

potential environmental impacts of products, services or projects over their full life cycle, being, therefore, a valuable tool to provide decision makers with information on inputs, outputs and associated environmental impacts of a defined system.

Social impacts evaluation is still a very young discipline. Due to the lack of standardization regarding social evaluation, an approach proposed by Ciroth and Franze (2011) was followed, with a rating system as the assessment method for the impact categories for each subcategory of each stakeholder.

Additionally, an integrated method based on traditional cost-benefit analysis is proposed to assess the three bottom lines simultaneously. Social Return of Investment, despite the social label, is an integrating method to assess the environmental, social and economic performance of a company or project.

To support the methods, a business model template is proposed. Triple Layered Business Model Canvas' layered format helps users to better understand and represent the interconnections and relationships between organizations' current actions and its economic, environmental and social impacts.

Furthermore, it allows economic, environmental and social value to be explored horizontally within their own layer and in relationship to each other through the vertical integration of these layers together.

The case study was a new business model developed in Portugal for a social coop project. This cooperative's main goal is to change the paradigm in society regarding the consumption of products that, due to aesthetic reasons are rejected by the conventional channels. The requirements imposed by large conventional retailers for fruit and vegetables, such as size, color, and shape are forcing farmers to have restricted control and selection policies and, only the products that are in full accordance with the imposed requirements are accepted. This coop commercializes these products that, despite being "ugly" do not have any quality problems.

This business model has been successful not only in social terms, as most social projects are, but also economically sustainable for more than two years. Different sustainability methodologies regarding the three pillars of sustainability were applied to this case study. The first approach was to map the business model through the triple layer model canvas, which allowed a broad perspective of the actors in the project and the potential economic, environmental and social impacts of the project for each.

Although not quantitative, it served as a framework to support the subsequent analyses. Furthermore, it was clear in the social layer the wide impacts of the project regarding not only the main issue, food waste, but also the community involvement, the association, and support to other social projects and the health-related aspect of promoting healthier food. The next analysis were life cycle based, and the LCC, LCA, and S-LCA methodologies were used. In this part, the importance of the state of the art and establishment of the methodologies to quantify each dimension was clear. While in the economic and environmental dimension the result was clear, in the social dimension and due to the inexistence of impact assessment methods and software as in the LCA case, the S-LCA is more subjective, and one of the proposed approached in the literature was followed, as it followed the UNEP guidelines.

The economic sustainability was proven by the investment appraisal method, and some interesting conclusions were taken from the project cost structure. This business model runs on very low investments, being the main costs the fruits and vegetables – that contribute to the increase of efficiency of the farmers – and the salaries of the staff – highly adjustable to the growth of the coop. This is one of the key success of the coop – the consumers are partners of the project and understand in a transparent way that their economic effort and commitment is channeled to the main aim, avoiding and valuing the waste in the farmers. The environmental analysis showed the benefit of avoiding the waste, as the transportation of the products has a lower impact than sending the products to landfill. This result is noteworthy as it was not clear to the coop the impact of the transportation and the balance with the avoided waste. One key factor for the environmental sustainability is the local consumption of the products, as the coop established a maximum distance for the transportation route among farmers and to the delivery point. This distance limitation is both important for the economic and environmental sustainability.

The social dimension was evaluated through the S-LCA method, a recent and in a development phase method. Some proposed indicators were used and not only showed but also quantified the aspects of the project that have positive and adverse effects on the different stakeholders. Being a social-driven project, in overall the results showed the expected positive social performance of Fruta Feia. Here, the key success factor is the prevention of food waste itself that drives people to engage with the project and actively fight for a solution to this problem connecting them with the local farmers who until now had no viable option for a relevant part of their products.

Finally, the three dimensions were evaluated simultaneously through the SROI method, a popular method both prized and criticized by researchers. One advantage is the monetization of all impacts, leading to a simple single score in € (easy to use, understand and communicate). However, this brings some simplifications and omissions of impacts, as for some it is not possible to find financial proxies. Besides that, it is stakeholder dependent and therefore subjective. There are no guidelines for indicators of impact, and therefore different people can reach different impacts and proxies for the same case study. In this case study, the transparency and availability of the coop allowed the author to discuss the results and to have full access to the required information.

This study analyzed the sustainability of a novel business model that aims to serve as a practical and replicable solution for a food waste problem. All environmental, social and economic indicators were positive, proving, therefore, the success of this model, already tested in Lisbon for more than two years.

The coop is now in a replication phase, still opening new delivery points in Lisbon and a new delegation in a new region, Oporto., being the social evaluation the one with more space for subjectivity and least established methods. Due to lack of tools (e.g. software), the experience with product assessments focusing on social aspects remains very limited.

In order to validate the proposed methodology, more case studies have to be analyzed. Preferably, applying the proposed methodology to different types of organizations (e.g. for profit with big dimension).

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