



Bickfaya - Mhaydsseh Municipal solid waste management plan

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CLIMA

Cleaning Innovative Mediterranean Action



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1. Introduction

1.1. Framework and scope of the project

The mismanagement of organic waste is one of the most important challenges for the years to come. According to the "Report on waste management at local and regional level in the Mediterranean region" published in 2014 by the Euro-Mediterranean Regional and Local Assembly (ARLEM), "it is becoming necessary to find sustainable and innovative methods of selective waste collection and disposal, with a view to meeting the challenges of climate change, so as to ultimately promote sustainable development in the Mediterranean". A 2013 Council of Regions stressed on the imperative adoption of the vision of "a zero-waste society, optimizing waste prevention and seeing waste as a resource within". While by 2020 the majority of EU Member States will be reusing and recycling at least 50% of their municipal waste, landfilling less than 35% of biodegradable waste, and recycling at least 55% of packaging, forecasts are not possible for North African Countries. CLIMA project, and its regional platform of Italian, Tunisian and Lebanese Municipalities, public agencies and NGOs, aims to cope with environmental, economic and social problems of organic waste mismanagement in three Mediterranean Countries, developing policy tools like the integrated Municipal Waste Management Plans (MWMP 2.0), innovative technical solutions like the COMPOST DRUM and 2 improved pilot compost sites, and supporting territorial enterprises actives in the circular economy, as well as information and advocacy campaigns to influence attitudes towards the zero waste and circular economy paradigm, at the domestic, public and industrial level. Through the project, around 80.000 citizens in 3 Med municipalities will live the benefits coming from the reduction of the waste production due to the increase of the treated organic waste, and the visible closing of the cycle production/consumption with the possibility of using high quality new eco-services and eco-goods.

1.2. Presentation of the consultant

arcenciel

Since 1985, arcenciel has worked with and for all people with difficulties for the sustainable development of society.

It is a non-profit, apolitical and non-confessional association that treats more than 80% of the hospital waste of Lebanon and more than 1,000 tons of solid waste a year.

www.arcenciel.org/en/

2. Managerial aspects of Solid Waste Management

2.1. Legal and regulatory framework

(LAW Number 80 - Integrated Solid Waste Management, Section II, Lebanon)

Article 11: Local solid waste management programs

(1) Each local administration shall prepare a draft local solid waste management program as specified in paragraph (3) of this article and in accordance with the contents of the strategy approved by the Council of Ministers and submitted to the Ministry of Environment with a copy to the Ministry of Interior and

Municipalities, to be duly approved, within a maximum period of three months from the date of approval of the strategy.

(2.) The Ministry of Environment should approve the programs referred to in paragraph (1) of this article within a period not exceeding three months from the date of issue of this Law and shall amend it when necessary or after a maximum of 10 years.

(3.) The clauses to be included in the programs referred to in paragraph (1) of this article shall be determined by a decision issued by the Minister of Environment, and shall include, but not limited to:

- a. Information about the local administration and its solid waste characteristics;
- b. Methods of collection and transport, including draft terms and conditions;
- c. Projects for sorting, treatment and final disposal in environmentally and economically viable ways;
- d. Supervision, monitoring and evaluation of collection and transport, and marketing of sorted and treated materials and others;
- e. Available human, technical and financial resources; and the need for technical or financial assistance;
- f. Collaboration with civil society for guidance on source reduction, sorting, treatment and final disposal of solid waste;
- g. Cooperation with the private sector to implement the local program.

(4.) Local administrations with similar problems in solid waste management may join forces to develop and properly implement the draft programs referred to in paragraph (1) of this article.

2.2. Institutions and their roles

Bickfaya is home to multiple NGOs, associations and institutions that intervene mainly in the humanitarian field.

Below we state some important actors within the community of Bickfaya and their roles:

- **Message de paix:** Provides a decent life, as well as educational, spiritual, medical and psycho-social support for adults with special needs.
<https://www.messagedepaix.org/>
- **Phénix Group Homes:** Provides residential care for the mentally disabled people and people with behavior disorder.
<https://www.facebook.com/PhenixGroupHomes>
- **Kelna Ayle:** Provides support – food and basic needs – to directly and indirectly affected families in Beirut and the surrounding areas.
<https://www.kelna3ayleh.org/>

- **Dispensaire St Vincent de Paul:** provides assistance and help to the poorer and supply them with their most urgent needs, also committed to social works as medical, educational, rural development
<https://stvincentlb.org/>
- **Bi Bickfaya:** coordinates and promotes all events that take place in Bickfaya, such as the Christmas market, flower festival etc.
<https://www.facebook.com/BiBickfaya>
- **Mouvement Eucharistique des Jeunes (MEJ):** Christian movement that is educational and apostolic targeting young people.
<https://www.facebook.com/mejbikfaya87>
- **Scout – Groupe Notre Dame de la Délivrance:** Voluntary non-political educational movement for young people.
<https://www.scoutsduliban.org/>

Some of the above organizations are often interested in implementing environmental activities, such as cleaning the streets of the village and raising awareness on the importance of sorting at source.

3. Municipality of Bickfaya

3.1. Presentation of the municipality

Bickfaya is a town in the Matn district region of Lebanon. The municipality includes the town of Bickfaya and Mhaydsee.

The town is at 950 m altitude, and having a surface of 5.5 Km².

Bickfaya is home to 2 presidents of the Lebanese Republic, parliament members and ministers.

The mayor Nicole Gemayel is the head of the city council composed of 15 members, 5 committees are also responsible for the designation of the tenders, the works and services, Supplies purchase committee for transactions by invoice and statement, Supplies receiving committee for transactions by invoice and statement and Committee of coordination with the Municipality of Sakiet el Misk-Bhersaf. The municipality is a part of “Federation of Matn Ech Chemali Es Sahli Oual Aoussat Municipalities (اتحاد بلديات المتن الشمالي الساحلي والأوسط”

<http://bmm.gov.lb/>

3.1.1. Role of the municipality in waste management

In the middle of the garbage crisis and other successive ecological crises, Bickfaya was a pioneer in finding a solution aiming at promoting the culture of sorting waste from source and in building the waste management plant of "Bi Clean".

The municipality is currently in charge of the waste collection and treatment at the Bi Clean facility without the assistance of a private contractor, and is responsible for the sweeping and overall cleanness of the town.

The collection is being carried out by 2 adapted trucks, whereas one is solely dedicated to the recyclable waste collection and the other collects all other waste.

During the Covid-19 outbreak, the municipality ensured that the waste produced by Covid patients was being collected separately, labeled by a red sticker on the bags in order to protect the employees and ensure that these bags are being handled carefully.

3.2. Population

According to Bickfaya municipality the population living in the village can be identified as below:

Population/permanent residents	Average	Winter	Summer
5000	6000	5000	7000

The increase during the summer season is due to Bickfaya’s cool climate and being a summer destination, having many hotels that accommodate tourists from around the world, many restaurants and attraction sites.

The ecological tourism is also very pleasant.

3.3. Buildings

There are around 1200 residential units in Bickfaya

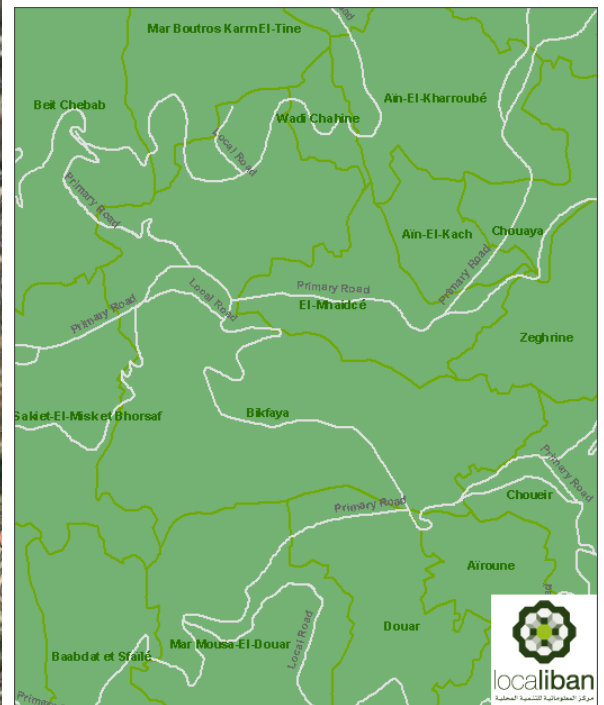
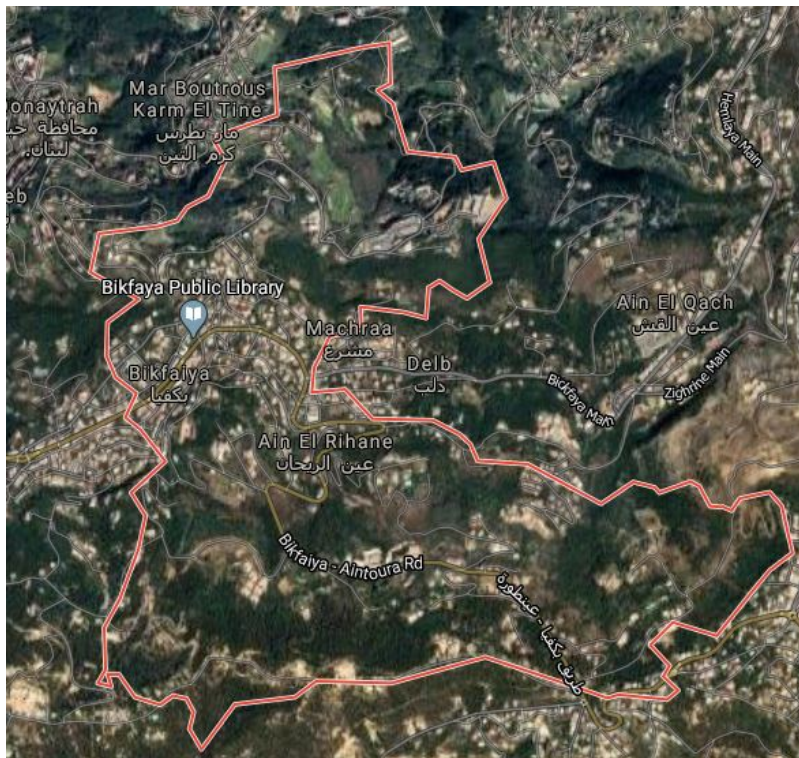
Unit type	Quantity
Buildings	1200
Restaurants	4 big restaurants
Bakeries & snacks	10
Schools	3
Hotels	1
Resorts	2

3.4. Maps

The coordinates, altitude and surface of Bickfaya are as follows:

Northing	33.9206°
Easting	35.6815°
Altitude	950 m ASL
Surface	5.5 Km ²

The towns of Bickfaya and Mhaysdseh were grouped into one municipality.



4. Overview on solid waste management

4.1. Waste source and streams

Solid Waste	
Municipal Solid Waste	<ul style="list-style-type: none"> ▪ Collection: <ul style="list-style-type: none"> ○ includes: household and commercial waste ○ daily production: 4.7 t/d (winter), 5.5 t/d (summer) ○ Average 0.94 kg/inh./day (min. 0.85, max 1.10) ▪ Local treatment: <ul style="list-style-type: none"> ○ HH and commercial: Biclean facility ▪ Final disposal of rejects: Sicomo –waste to energy ▪ Garden cleaning and street sweeping: Biclean facility
Other streams	<ul style="list-style-type: none"> ▪ Industrial Waste: limited quantities ▪ Construction and demolition waste: N/A ▪ Combustible Waste: N/A ▪ Slaughterhouse Waste: N/A ▪ Infectious waste: Handled by arcenciel

4.2. Solid waste generation

Small seasonal variations between summer and winter were observed for organics, paper, plastic and glass fractions. The per day generation rate during winter and summer, was calculated from the daily quantity of waste arriving to the sorting facility which was obtained from the concerned municipal authority. The highest values were found in summer compared to winter.

4.2.1. Winter quantities

Daily weight received	Organic + other waste	Recyclable	Other waste	%
Monday	4,215	1,402	-	20.26%
Tuesday	3,310	2,419	-	20.66%
Wednesday	2,090	2,140	-	15.26%
Thursday	2,420	1,722	262	15.88%
Friday	2,805	1,663	-	16.11%
Saturday	1,650	1,629	-	11.83%
Average	2,748	1,829	44	16.67%

Date: December 2020

4.2.2. Summer quantities

Daily weight received	Organic + other waste	Recyclable	Other waste	%
Monday	5,058	1,682	-	20.26%
Tuesday	3,972	2,903	-	20.66%
Wednesday	2,508	2,568	-	15.26%
Thursday	2,904	2,066	314	15.88%
Friday	3,366	1,996	-	16.11%
Saturday	1,980	1,955	-	11.83%
Average	3,298	2,195	52	16.67%

Date: December 2020

Day	Net (kg)	%
Monday	4,630	28%
Tuesday	3,180	19%
Wednesday	2,135	13%
Thursday	2,225	13%
Friday	2,390	14%
Saturday	2,205	13%
TOTAL	16,765	100%

Composition of the organic sample

Sample #1	% organic fraction	79.8%
	% non organic fraction	20.2%

Key findings:

- Average quantity of **Organic Municipal Waste** received per day = **2,794 kg**

- Average quantity of **Green Organic Waste** per day = **350 kg** (leaves, garden waste ...)

- Average quantity of **PURE Organic Municipal Waste** received per day = **2,230 kg**

- **TOTAL ORGANIC WASTE PER DAY = 2,580 kg**

Date: May-June 2022

The major fraction of organic waste which accounts for 59.8% and 79.8% of the total MSW collected during the winter and summer respectively. On the other side, the inorganic fraction accounts for 40.2% and 20.2 % in winter and summer respectively. The results indicate that the weight of the food waste are approximately 20 percent higher in summer than in the winter.

4.2.3. Additional waste quantities handled by the municipality

The Bi Clean facility is currently treating additional waste coming from the neighboring village of Ain El Kharoube.

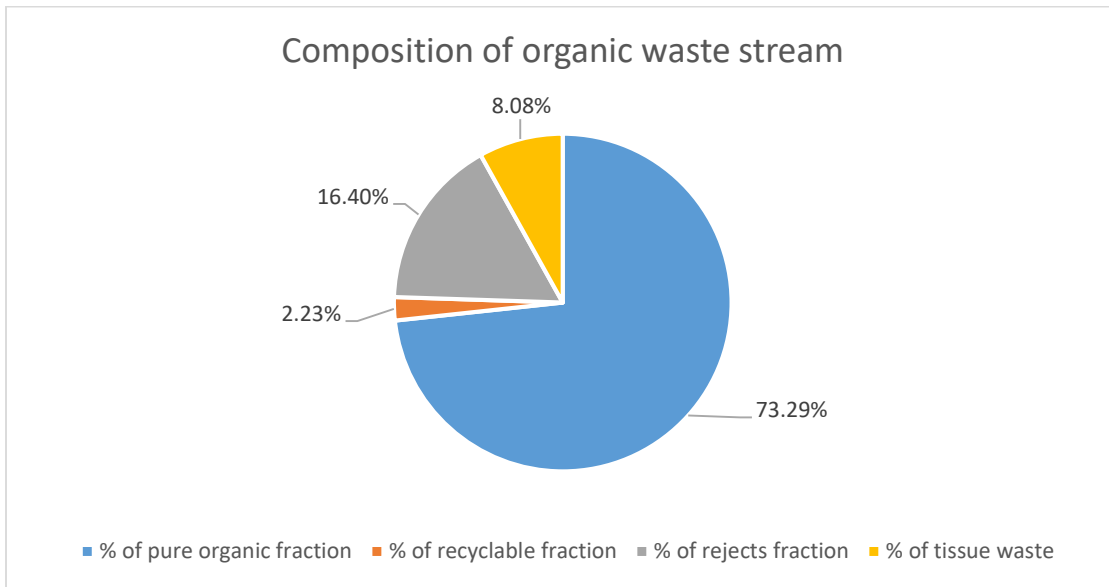
The average waste quantities received by the facility are as follows:

Type of waste	Weight	Frequency
Recyclable	500 KG	Weekly
Organic	1,000 KG	Weekly

These quantities are being delivered by Ain el Kharroube directly to the facility, therefore no additional transportation cost is being charged.

4.3. Solid waste composition

4.3.1. Composition of organic waste stream



The results clearly indicate that the composition of organic waste is dominated by food waste (mixed). It mainly includes leftover food residues, vegetable waste, leaves and decayed vegetables. Therefore, in Bickfaya the high quantities of food waste are generated from household and commercial establishments such as restaurants and hotels.

4.3.2. Density of organic waste

Average density (kg/m³)	0.534
Average density after shredding (kg/m³)	0.513

February – march 2020 Average density (kg/m³): 531.589

Density of the organic sample

Sample	Size (m ³)	(kg)	Density (kg/m ³)
Sample #1	240.00	101.75	0.424
Sample #2	240.00	92.35	0.385
Sample #3	240.00	103.1	0.430
Average density (kg/m³)			0.413

May – June 2022 Average density (kg/m³): 0.413

Density allows you to convert between weight units (kg) and volume units (m³). Where Shredding the material makes it more uniform in size, aerates it, and makes it easier to handle and keep moist. Smaller particles enable the compost to heat more evenly, and to withstand excessive drying at the surface. Particles too large can be forked or screened out or broken up when necessary.

5. Solid waste treatment

5.1. Secondary sorting facility

During the waste crisis in 2015, the municipalities were forced to implement any solution on the spot due to the high quantities of waste that were stacked in the streets.

The municipality of Bickfaya took the initiative of constructing their own waste management facility without the assistance of a private contractor.

The facility first became operational in March 2016.

Bi Clean is currently treating all the waste collected from the municipality of Bickfaya, and receiving additional waste quantities from Ain el Kharoube municipality.

The following machines are used in the facility:

Machine type	Quantity
Conveyor belt	3
Compressor	3
Glass crusher	1
Green shredder	1

5.2. Collection and transportation system

Truck A. specifications	
Model year	2017
Brand name	Isuzu
Capacity	0.6t
Compactor	N/A
Loading	Manual



Truck B. specifications	
Model year	2017
Brand name	Toyota Hino
Capacity	1.4t
Compactor	N/A
Loading	Manual



The collection is carried out by the municipality using 1 closed truck (**Truck A.**) and 1 open top truck (**Truck B.**).

Both trucks operate simultaneously while Truck A. collects recyclable waste and Truck B. collects organic and non recyclable waste.

The town of Bickfaya is divided into 2 collection areas (Upper Bickfaya and Lower Bickfaya):

- Upper Bickfaya is collected on Monday/Wednesday/Friday
- Lower Bickfaya is collected on Tuesday/Thursday/Saturday.

The collection is currently done using the door to door approach, public bins are non existent in Bickfaya in order to ensure the good quality of sorting and accountability in case of errors or non compliance.

The cost of transportation as per the municipality is as follows:

Collected by	Municipality
Pick ups	2 trucks – 4 employees
Collection frequency	6 days per week (Monday – Saturday)
Time for collection	From 7:00 am to 2:00 pm
Collection fees	<p>46 million LBP of salaries/year</p> <p>Approximately 266.67\$/month for the maintenance of trucks (Black market rate)</p> <p>120 L. of diesel/ week – approximately 81\$ (Black market rate)</p>

6. Awareness strategy

6.1. Awareness methodology

Upon the launch of the operations at the Bi Clean facility, the municipality of Bickfaya raised awareness on the importance of sorting from source using various methods such as the door to door approach and social media campaigns.

In an effort to gain citizens trust, and guarantee the operations outcome, volunteers from the village of Bickfaya launched a door to door campaign where they distributed flyers to the citizens explaining the process of sorting and recycling and its benefits to the village of Bickfaya.

6.2. Activities and campaigns

Throughout the course of the project, multiple methodologies were used to increase awareness among the citizens of Bickfaya, a well-tailored communication plan was drafted to meet the needs of the community and ensure its success.

During the Covid-19 pandemic, the focus shifted to online campaigns in order to maintain the awareness activities ongoing.

Social media posts, webinars, facebook live videos were implemented reaching a large audience not only in Bickfaya, but among the Lebanese citizens as well.

Once the pandemic was under control, it was time to focus again on the physical interaction with the citizens of Bickfaya, this included training of trainers, environmental booth in festivals held at the municipality, training and plantation activities with schools, village clean days and many more activities.

A big scale organic waste campaign was also launched at Bickfaya, with big printed billboards within the municipality, one on one meetings and trainings with big hotels, restaurants and markets were also implemented in order to ensure the proper sorting of the organic waste since the composting membrane was recently launched and will become operational soon.

6.3. Materials

Below are some of the materials used during the launch of the operations at the Biclean facility, a dedicated facebook page was also created where all the activities and the materials were shared.

The facebook page is updated regularly, and constant reminders are designed and shared to serve this purpose.

<https://www.facebook.com/BiCleanleb>

<https://www.facebook.com/bickfayamunicipality>



Within the framework of Clima project, many posters, flyers, billboard and social media posts were designed focus on reducing, reusing and recycling, organic waste management.

Below are a few samples of the work.

Don't WASTE a minute Keep Sorting

CLIMA

نعيد التفكير بدوام رفع النفايات :

أيام الاثنين والاربعاء والخمسة هي الأيام المخصصة لجمع النفايات من الطابق العام ،
وأيام الثلاثاء والخميس والسبت هي الأوقات المخصصة لجمع النفايات من الطابق العام ،
كما يرجى وضع النفايات المخصصة للبناء في الحاويات الخاصة بها أمام مساكن البنية
ممنوع وضعها في الحاويات الأخرى مخصصة لجمعها . تحت التسمية CLIMA تنظيم
مخاض خدمة باقي المداخلين.

CLIMA

زرعنا وحصدنا بيئة نظيفة حلينا عم نفرز

CLIMA

ZERO Waste

STOP USING PLASTIC BAGS.
START USING REUSABLE BAGS!

CLIMA

أمرز نفاياتك بشكل صحيح SORT YOUR WASTE CORRECTLY

CLIMA

Keep sorting your waste you're making a difference

كقل فرز نفاياتك
تم تعمل كل الفرق

CLIMA

Think smart REUSE

CLIMA

Never Refuse to Reuse

CLIMA

LESS PLASTIC USE

CLIMA

من صحتك لجنينتك

CLIMA

أمرز نفاياتك العضوية بشكل صحيح

نفايات المطبخ
فشار الخضار والفواكه، بقايا الوجبات والخبز.
نفايات الحديقة
الخضار والفواكه، بقايا التشحيل.

CLIMA

REFUSE SINGLE USE PLASTIC

REUSE CHOOSE REUSABLES

REDUCE PLASTIC POLLUTION

CLIMA

COMPOST Choose To Act Green

CLIMA

7. Financial model

7.1. Costs and resources

Calculation of costs	Recyclables and organics
	Facility with collection
Total fixed cost (per year)	\$313,300.00
Salaries of employees	\$295,200.00
Awareness campaigns + workshops	\$10,600.00
Insurance (all risks)	\$7,500.00
Total variable cost (per year)	\$192,637.00
operational cost	\$59,305.00
collection and transportation cost	\$20,347.00
landfill disposal	\$212.00
cost of equipment maintenance	\$12,753.00
consumable cost	\$100,020.00
Total cost per year	\$505,937.00

List of revenues Monthly sales of materials			
Type of materials	Quantity (kg) or (Inhabitants)	Unit price (\$)	Total (\$)
Metals + aluminum	4486	1	4486
Paper and cardboard	9826	0.04	393.04
Plastics (HDPE,PP)	2667	0.22	586.74
Plastic bottles (PET)	2898	0.2	579.6
Plastic films	2755	0.17	468.35
Glass	3520	0.5	1760
Compost	15000	0.1	1500
Total waste revenues (\$) per month			\$ 9,773.73
Total waste revenues (\$) per year			\$ 117,284.76
Treatment fees per inhabitant	20000	28.85	577000

7.2. Net results

The following summarize the financial model of the project:

Capital:

670,068.67 USD; it includes the cost of the equipment, the construction of the plant, and its commissioning.

List of Annual revenues per year: Total of 117,284.76 USD

Sales of Waste:

1. *Metals and aluminum sales per month: 4486USD;*
2. *Paper and cardboard sales per month: 393.04USD;*
3. *Plastics (HDPE, PP) sales per month: 586.74 USD;*
4. *Plastic bottles (PET): 579.6 USD;*
5. *Plastic films sales per month: 468.35 USD;*
6. *Glass sales per month: 1760 USD;*
7. *Compost sales per month: 1500 USD;*

Total revenues (\$) per month: Total of 9,773.73USD

While, Treatment fees per inhabitant/year: 28.85 USD;

Treatment fees per inhabitant/year: Total of 577,000 USD

List of Annual expenses: Total of 560,913.89 USD

1. *Salaries of employees: 295,200.00 USD; it is a full time salary for all employee to manage the plant operations during the year.*
2. *Awareness campaigns and workshops: 10,600.00USD;*
3. *Site Insurance (all risks): 7,500.00 USD;*
4. *Equipment maintenance: 12,753.00 USD;*
5. *Land rental: 25,500.00 USD;*
6. *operational cost: 59,305.00 USD;*
7. *collection and transportation cost: 20,347.00 USD; It is the cost of collecting the sorted waste and delivering it to the site.*
8. *landfill disposal cost: 212.00 USD*
9. *consumable cost: 100,020.00 USD*
10. *Depreciation: 442,153.33 USD; calculated for the equipment over 15 years. The reason that we included it in the cost is to be able to renew the plant at its end of life after 15 years.*

Net Revenue of 110,697.82 USD

Results:

At a weighted average cost of capital (WACC) of 5% on the total capital of 670,068.67 USD and 15 years as life of the project:

- **478,936.88 USD** net present value (**NPV**)
- **7.25% modified** internal rate of return (**MIRR**), calculated at 2% reinvestment rate
- **< 8 years** as **dynamic payback period**
- **14.29%** internal rate of return (**IRR**)
- Renewal of the plant for another **15 years** after its end of life

8. Planning and recommendations

1- In order to keep the operation profitable and sustainable, treatment fees/inhabitant must be taken into consideration otherwise, the revenues from selling only the recyclables and compost will not cover the operational cost.

2- In order to increase the revenues of the facility, it is recommended to sell 100% of the recyclables and compost, therefore to reach this target it is important to do proper source sorting by the waste generator (industrial waste, household waste, commercial waste, etc..).

3- Put strategic collection points, in order to know exactly where to place the bins within the residential areas so that it would be accessible for all inhabitants, thus decreasing the collection fees.

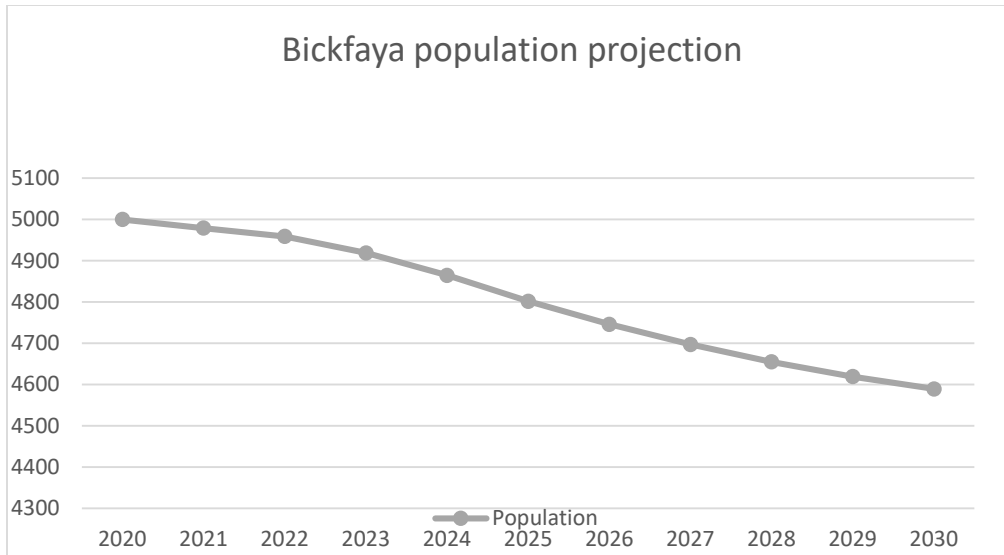
4- Drafting agreements with surrounding municipalities to collect their sorted waste will impact positively the net profit and will ensure the continuity of the operations.

5- It is recommended to keep on doing public awareness about the importance of sorting and composting.

8.1. Waste generation in the future

Waste generation can be calculated in reference to the increase or decrease in population within the village, below is a table showing the average population for the years 2020, and a projection for the years 2025 and 2030.

Year	2020	2025 (-1.29)	2030 (-0.64)
Permanent residents	5000	4802	4590



According to worldpopulationreview.com, a decrease in Lebanon’s population is expected due to multiple factors, mostly due to the economical crisis and immigration.

As a result of this decrease, and taking in average the production of **0.94 kg/inh./day**, we expect a reduction in waste generation by 8.5% in the future at least by the year 2030.

Year	Average permanent residents	Waste generation
2020	5000	4.7t/day
2025	4802	4.5t/day
2030	4590	4.3t/day

9. Annex

Annex 1- Law number 80 – integrated solid waste management

Annex 2 - Financial model- Bickfaya- Clima project