REPIC

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Final Report:

Plastic Recycling Project

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Contents

1. Summary

Maximum of 1 page, containing the most relevant information; particularly:

Why was this project implemented (Needs in the partner country)?

What was implemented (project's content)?

How was the project carried out and what objectives have been achieved?

What do you foresee as further actions to be undertaken?

Since the founding of the Republic of Liberia, it is embossed by the history of slavery. Still today it is mostly the «Americo Liberians» who have more privileges than other peoples. This was also one of the triggers for the civil war (1989 - 2003) whose consequence are still noticeable today. During the civil war, the population in the capital Monrovia quadrupled. The infrastructure did not and still cannot cope with this concentration, therefore most of its inhabitants still live without electricity, water supply and without primary sanitation services. The massive spread of the Ebolavirus (2014 / 2015) was a direct result of a long unattended structural problem. However, the non-functional health system is only one aspect of the inadequate infrastructure in Liberia.

Most parts of the metropolis do not have an organized waste disposal. Incineration- or recycling sites do not exist in Liberia and the country lacks policies around this fundamental issue. Through an Emergency Monrovia Urban Sanitation (EMUS) project sponsored by the World Bank, the waste of bigger dumpsites in town is being transported outside of town to a landfill. These transports are unreliable and do not resolve the waste problem of Monrovia. The challenge of dumpsites and landfills are that they contaminate the rainwater and because of the lacking sanitary conditions, there is a high danger of infectious diseases. The EMUS project focused exclusively on collection and disposal, and it ended in 2017. If the 'best-case scenario' is, that the waste is burned openly within the communities or transported to a landfill outside of town, that leaves most of the waste volume ending up in canals, lagoons, and beaches. The effects of especially plastic waste that ends up in the ocean are well known. the only thing that helps here is to collect, raise awareness and offer alternatives to prevent the final disposal in the ocean.

In this context Green Cities initiated the «Plastic Recycling Project». On a local level it challenges the waste management issue in Monrovia. With a waste value chain, Green Cities engages for a clean environment, a sustainable handling of resources and creates job opportunities for young adults.

The «Plastic Recycling Project» does pioneer work in Liberia by processing solid plastic waste and bringing the resource back into the market.

Major milestones achieved 2018-2021

- Decentralized collection of waste products
- Electricity supply and machine installation
- Production of end products for awareness and sale
- Enhancement of storage space
- Training and further education of employees and suppliers in various modules of 'the Recyclist' by Fair Recycling
- Sales of products demand by economy

Main challenges ahead

- Increase production and sale of products
- Increase of collection and transportation of recyclables
- Expansion / franchising

Sustainability plan

- Green Cities is gradually covering more and more of the local expenditures by its own generated income, until full self-coverage will be reached

2. Optional: Abstract in local language

If relevant, an abstract in the language of the country where the project was implemented.

3. Starting Point

Short description of the initial situation at the project's start.

Green Cities Inc. (www.greencitiesinclr.com) is a youth bases social enterprise operating Liberia's first waste segregation and recycling program. The goals of Green Cities are to create clean and green environment through a waste value chain and to also use waste value chains as a means of creating job opportunities for youths and women. To achieve these goals, we engage into the following: waste collection and sorting, buying, and selling of recyclables, organic fertilizer production and its application, plastic recycling, electronic waste recycling and paper recycling. We also manage medical and chemical wastes.

Waste Collection Services
Our waste collection service is a win-win style for our customers. We provide special kind of recycling bags for our clients and encourage them to separate their wastes into various categories. To start this, we train our clients maintenance staff on how to separate their wastes. We discuss about Green Cities activities, waste separation, the main waste that are purchase by Green Cities, and proper waste strategies. We guard clients in identifying smaller garbage bins that can be placed in their offices for the putting in wastes before taking to the general waste bag.

Plastic Recycling
Green Cities Inc. uses two methods when it comes to recycling plastic. Mechanical and chemical recycling of plastic. Mechanical recycling of plastics is the processing of plastic waste into secondary raw material or products without significantly changing the chemical structure of the material. In principle, all types of thermoplastics can be mechanically recycled with little or no quality impairment.
With this form of recycling, we are currently producing geometric tools for schools and cup for rubber farmers.

Rubber Latex collection cup

Geometric Set for students

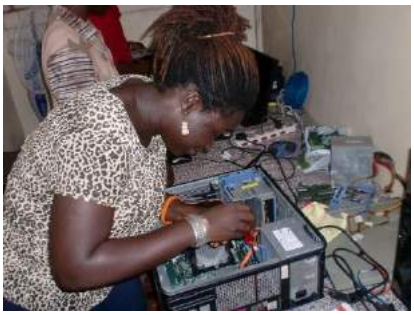
The leftover plastic after production, is then recycled using chemical recycling process of plastic. Advanced plastics recycling, also called chemical recycling, refers to several different technologies that convert post-use plastics into their original building blocks, specialty polymers, for new products like fuels, gasoline, kerosene, carbon black, and other valuable products. With this form of recycling, we are producing diesel, gasoline, propane gas and carbon black.

Organic Waste Recycling

Green Cities methods of recycling of organic waste come in three forms. Biogas production, animal feed production and organic fertilizer production. Currently we are doing organic fertilizer and planning to expand into animal feed and biogas production.

Electronic Waste Refurbishing and Recycling

Sustainable e-waste management through refurbishing and recycling is an income line of Green Cities that focuses on giving a second life to solar energy wastes (like solar panel, cookstove, solar light, etc.) and other electronic wastes through refurbishing and a final implementation solution through recycling. E-waste is very hazardous and as such, it pollutes our soil and water. We focus on refurbishing solar electronic waste and selling the end products to poor income households. E-waste like computer, television, radio, light, etc., can also create sustainable job opportunities for young people through recycling and refurbishing.



Other Activities of Green Cities Inc.

- Buying of recyclables (like aluminum cans, Heineken bottles, mineral water bottles, water plastics, used gallons, iron, used car batteries, etc.)
- Pest Control
- Awareness/Sensitization in environmental sustainability

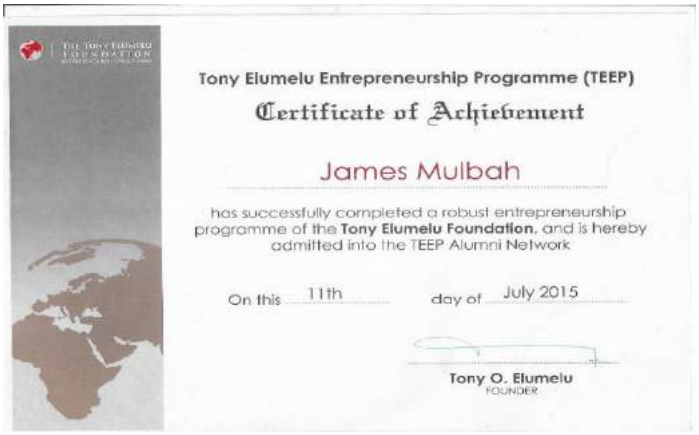
Some Local and International Organizations we have worked with for Projects Implementation in the Waste Sectors are:

- World Bank Liberia – Grant Prize
- Global Communities – Youth Empowerment in Service Delivery – YES Project
- ActionAid Liberia – Urban Youth Recycling Project in five communities
- US Embassy – Environmental Awareness during the Ebola period in Liberia
- United States Africa Development Foundation USADF – Grant Prize from the Mandela Washington Fellowship Program in the United States
- United Nations Mission in Liberia UNMIL – Urban Youth Recycling Project in ten communities
- Cooperaxion (REPIC, Julius Baer Foundation, Temperatio) – Plastic Recycling Project
- Fair Recycling (REPIC, Julius Baer Foundation, Temperatio) – Plastic Recycling Project
- Tony Elumelu Entrepreneurship Program – Organic Fertilizer Production
- Orange Liberia – Second Grant Prize Winner Social Venture Fund
- Africa Entrepreneurship Challenge Fund – E-Waste Recycling Project

Some of our Customers

- United Banks for Africa - Waste Collection
- Banjaj Motor Company - Waste Collection
- Coca Cola Bottling Company - Waste Management
- Sunny Brothers - Waste Collection
- Allen Printing Press - Waste Collection
- Morris American Rubber Company - Production of Rubber Latex collection cups (350,000pcs, ongoing)

Awards and Recognitions



4. Objectives

Description of the project's original objectives.

The «Plastic Recycling Project» has constantly developed over the last years. 2016, a crucial amount of recycled raw material could be sold back into the plastic industry. 2017, many important contacts were established including a trader in plastic machinery who could supply the washing line for foil plastic within West Africa alongside with technical support. At the same time, the project initiative and its new opportunities for waste management had been presented in various occasions and to different target groups. Not all ideas could be implemented, though the planed milestones have been reached and the social business is on a promising track and has developed extraordinarily despite the difficult infra-structural, political, and economic basic conditions. To install a sustainable system for combating the waste issues in Liberia, this project mainly focused on the following objectives:

- The time-consuming washing and drying of the collected plastic waste is mechanized
- The collected plastic waste is being transformed into a new end-product
- Awareness campaign: various actors are involved in the recycling process

5. Project Review

5.1 Project Implementation

How was the project carried out (approach, partner and project's main steps)?

Did the project's main objectives have to be modified during the course of the project? Describe any of the modifications made.

With a waste value chain, the Liberian social business Green Cities engages for a clean environment, a sustainable handling of resources, raising public awareness and creates job opportunities for young adults.

This goal and approach have never changed. Also, the main objectives have not been changed. However, we did have to reconsider the timeline and break down some of the milestones. Looking at the international challenges, we did a reassessment of the milestones that were originally defined with REPIC in 2018. Two of the three milestones were defined in partial steps. Based on our experience and the current economic situation, we tried to define feasible goals while remaining committed to our overall goal. We also added a few intermediate milestones and finally we had to adopt also to the measurements and side effects of the Covid-19-pandemic.

These are the agreed upon milestones between REPIC and Fair Recycling in October / November 2020:

- M1: - A new end product is produced, tested in 2 or more public classes, sold (2 tons) via the education system and retailers and formally presented to the public.
- M2a: - Youth groups were trained as "collectors" and decentralized sales/purchase centers (5 groups with 10 people).
- M2b - Onsite evaluation of waste management and technical processes (decentralized collection and storage points, centralized processing) based on Swiss Experts Know-how completed.
  - Evaluation report including recommendations for further process improvements available.
- M3a: - Five (5) new decentralized collecting points are operational in Monrovia's districts. (namely: Redlight, New Kru Town, West Point, Duport Road, and Plumkor community).
  - the extended central storage site with a storage capacity for 50 tons of processed plastic is operational.
- M3b - Processing capacity (crushing and pelletizing) reached 20 tons per year by the end of 2021; 5 tons of plastic waste processed in 2021.
  - 8'000 geometry tool sets and 60'000 rubber cups produced by the of 2021.

5.2 Achievements of Objectives and Results

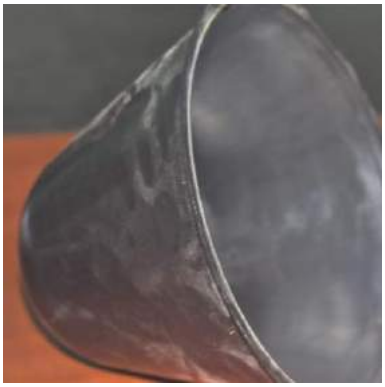
To what extent were the objectives achieved? Which results were achieved?

Production of End Products – Milestone M1

Two end products can now be produced at Green Cities out of the collected recyclables: geometric tools and rubber cups for latex collection. These are produced with the new injection machine from China with two separate molds. The pilot analysis below is from May 2020 when this milestone one was considered reached.

Due to the closed boarders, the supply of virgin plastic was challenging. Other than that production can still go on. Also, the buying of the materials is still ongoing to fulfill the social aspect of the project and support the community members and to keep the customer relationship ongoing. Now (February 2022), the production has increased and is more customized, see milestone M3b.





PILOT PRODUTION ANALYSIS

Raw Material		**Costs**
20%	50 kg virgin plastic	145.- USD (inkl. import)
80%	200 kg recycled plastic	45.- USD
		190.- USD

The virgin plastic is needed for elasticity and durability of the products.
The recycled plastic is a combination of 60% hard rubber (gallons) and 40% foil plastic (from water bags).

1 kg of recycled plastic is bought at 25 Liberian Dollars, so 200 kg costs 5'000 Liberian Dollars
1 USD is changed for 199 Liberian Dollars so this are about 25 USD
additional 20 USD are spent on electricity, manpower and other costs

Production of End Product
Out of this 250 kg raw material:
4'210 rubber cups and over 500 geometry tools (each consist of 3 pieces) were produced
For the rubber cups 3 to 4 days of 6 working hours have been invested
For the geometry tools 5 hours have been invested
Each time, a team of 3 persons was involved

Sales	**Income**
The rubber cups could probably be sold for about 0.13 USD (through the Rubber Planters Association)	547.30 USD
The geometry tools probably only for 0.30 USD (not as originally planned for 1.50 USD, through the Consolidated School System)	150.- USD
	697.30 USD
Current projection on gross profit	507.30 USD

It has turned out, that schools like to visit Green Cities to educate their children. We can see that in a contribution on the Liberian national TV, which happened to be on the same day where a school made a field trip to the recycling site: https://youtu.be/bqw34PkduBc.

James has had several meetings with the city mayors of the most populated cities around Monrovia (Paynesville, Gbarnga, Ganta, Buchanan, and Kakata). They also came over to Green Cities to visit our facility. They were very impressed and are happy to work with us. It is very important to have the approval of the city authorities to carry out awareness in their areas.

Employees of Green Cities will travel to various schools (target: ten schools) and raise awareness to the cycles of reduce – reuse – recycle within the schools using the geometric sets produced out of 'waste'-materials. Due to the COVID-19 restrictions in some places and to limit the cases, we decided to postpone this until the health crisis has been reduced. We also do not want to risk our team, but we are in constant communication with schools and communities for outreach.





Training for Community-Collectors – Milestone M2a

We trained 50 young people. These groups are from five different communities (districts of Monrovia): West Point, Slipway Community, Duport Road, Buzzi Quarter, and Redlight.
We recruited them already in 2018 for another project but now did focus on the new activities at Green Cities.
This training was done within three days from July 10 to the 15 2021, taking into consideration social distancing, meaning, we had to do it over Zoom. The participants from the 5 districts where split in three groups.
The training focused first on health and safety information around COVID-19, then on various waste material (not only plastics) that have value, on how the collection could be done safely even with all the restrictions because of COVID-19. The participants learned how to partner with Green Cities in the areas of collection, storage and selling (a specific schedule was set up, when which group would be selling to Green Cities).

Evaluation Report & Swiss Know-how Transfer – Milestone M2b

Another challenge caused by the pandemic is the travel ban. The trip of project coordinator Marianne Naeff had to be postponed for November 2021. In the meantime, Marianne and James hold weekly Skype sessions and with the extended team of Fair Recycling.

We had to be creative in setting up the onsite evaluation and the Swiss know-how transfer. However, we figured a suitable solution: The evaluation was set up in a way that questions were designed by Heinz Gfeller, CEO of Fair Recycling, and together with James we looked for an external evaluator who is already based in Liberia. We found him in Aaron Massayan Kollie, Assistant Professor at the Department of Biology and Public Health in the University of Liberia, having a strong focus on environmental public health. He chose the method, conducted the interviews, and put together a narrative report of his findings in an evaluation report. Also there has been a video produced that interviews Green Cities staff.

Another central way of Swiss know-how transfer was done through the online trainings Fair Recycling developed:

Fair Recycling is internationally known for its established online trainings for recyclists in emerging countries. The course offers disadvantaged people access to the labor market and protects them from damage to their health. In ten modules the participants learn about the processing of different materials such as plastics, metals, electronic waste, etc.

As a pilot the employees of Green Cities as well as some external students have started the training and have so far graduated the first two modules of work safety and domestic plastics. They have been handed a certificate of achievement from Fair Recycling. In the questioner given at the end all employees stated that they are eager to continue the training.


More Details on the Swiss Know-how Transfer

Project Management

Since the beginning of the project, it was always accompanied by Swiss project manager Marianne Naeff. This accompaniment consisted roughly of a 20% employment and included organizational and strategic support, establishment of relevant networks, and relationship with donors. The more the project developed a functioning waste value chain, the Swiss know-how transfer focused not only on skills and quality in production, but also on marketing and finding potential partners who are interested in buying the products produced by Green Cities. Additionally, the resources and privileges, coming from having a *white* Swiss project manager, were also used to establish connections locally in Liberia and internationally, because it sometimes has another weight or credibility if the Liberian partner can bring along a Swiss partner to an important meeting.

Fundraising
Fundraising includes much more than just looking for money, it starts with structuring a project in a way that simplifies the impact, outputs, outcomes, etc. in ways that make it attractive for partners to join the project. It includes pitching the project, presenting it, and following up with potential donors. It also includes reporting and answering questions. During this whole time of partnership, one of the central ways of Swiss know-how transfer, was in training the Liberian partners to understand and possibly assimilate to Swiss standards in project proposals, reporting and relationship building. So that eventually, in case there are still funds needed, this connection could be done directly between potential donors abroad and the local implementing partner. Swiss partners that we won in this way include the Rotary Club and the Peter Baumann Foundation. With the attempt to gain also locally anchored financial support, we had various meetings with potential partners: World Bank & City Authority, the Rockefeller Foundation and "100 Resilient Cities", Teresa Montana, "Cross Cultural Care", Swedish Development Aid, and ActionAid.

Networks
An uncountable number of networks have been established over these years which focus on the one hand on content exchange, eg. InnoRecycling, AppollForum, FiBL, Mare Nostrum. At the Julius Baer Conference in 2019 (that invited James Mulbah to come to Switzerland) many connections were built with other organizations, individuals, and partners around recycling. The Julius Baer Foundation also sent one of their employees, Philipp Widmer, to Liberia to evaluate the projects for themselves. As mentioned above some networks were also established in Liberia with the Swiss project manager being involved: With the Ministry of Youth and Sports, the “Waterbag Producer Association”, the City Mayor of Painesville, and with various non-profits who are interested in waste management such as Advancing Youth (USAID), Liberia WASH Consortium, Oxfam, IBIS, Public Services International, German Agro Action, and Action Against Hunger.
Commercial partnerships that look now at buying Green Cities products which included Marianne’s own established networks within Liberia and abroad are: Eco-Lodge Libassa, Tropicana Beach, Hydro Whiteplane, and Wildplastics (wildplastic.com).

Know-how Transfer is both ways
We would like to emphasize that even though the Swiss know-how transfer played a major role in this project and is important to outline in detail, it is as well important to acknowledge the know-how transfer that was made in the other directions. Many individuals, organizations or rising projects in Switzerland contacted us to learn from us and from the local set up of this project. We always took our time and share all our lessons learned because we want to see the world moving forward on the issue of (plastic) recycling. However, it often also took a lot of our time without receiving any reimbursement of any kind. That is sometimes challenging for a small organization and business that has challenges on so many ends and then also needs to take its time to inform others who learn from our work but don’t give anything back. We would simply like to emphasize that this know-how transfer is something that functions in both ways and is not a one-way stream of Swiss know-how being given to Liberia. We are benefitting a lot from all the work and experience that is been done in Liberia or other emerging countries.

Project Visit
In November / December 2021, project Marianne was finally able to pay a visit on ground again after two years. During that time she visited at least twice all facilities: The processing site in the center, the new storage facility in Mount Barcley, the oil production (pyrolysis) in Benson Ville.
She was part of a delivery of customized cups to the rubber company MARCO and withnesed them taking a video testimonial where the owners shared the positive impact of this new product on their production and sales. She experianced different post consumer and post production waste pick-ups at the Coca Cola Factory, DUCOR Water Bags, and Community Based Enterporizes in Topoe Village and was part of winning new partners (Hydro in Whitelane). We organized virtual and in-person meetings with the new partners: PLASTICA Côte d'Ivoire, Action Aid, Wildplastic, Rotary Club, and Peter Baumann Foundation. Marianne participated in a workshop led by an expert engaged by AECF, Doris Idahor, for the entire team on “Performance Management”, where, among others, each staff member

formulated his/her KPA and KPI's. And, together with the CEO, we worked on reportings and the new strategic planning.

Overall I, Marianne, can say that everything commnicated through our phone calls, pictures, videos and written communication as well as the financial and narrative reporting and the external evaluation: all what I saw on ground corresponded with what I was communicated. Furthermore, I was very impressed by the milestones reached, by the teamplay, the quality, the feedback of parters and the immens impact the project has.
Green Cities is doing an excellent job in a difficult context, it is particularly impressive that all our expectations have been met despite all difficulties. The team is commited and contributing with a huge effort, without which it would not be possible to overcome the obstacles. There is always more to achieve, but for a overall review, a lot has been achieved, we can all be very proud.

Decentralized Collection Points and Construction of Storage Facility – Milestone M3a

Already in milestone M2a we described that 50 young people were trained as decentralized collectors in five communities (West Point, Slipway Community, Duport Road, Buzzi Quarter, and Redlight). Since then, these collection points are set in place and functioning. However, due to COVID-19 some were not constantly operating because the teams in these collection points are not always at the sites. On these first three pictures, we see the collecting youth organization called “Community Friendly” at Harmon Failed Community in Redlight, Paynesville:




Also, a big facility for the storage of collected plastic from various communities has been built and will help to upscale the project because now more products can be bought and processed, therefore, bigger orders can be accepted. It has a storage capacity of much more than 50 tons of processed plastic (95 x 40 feet). With the aim to be mostly done with the work before the full start of the rainy season, the construction was finished by the end of June 2021:





Increased Processing Capacity and Production – Milestone M3b

This milestone has now been achieved. We crushed 16.2 tons of HDPE plastic, washed 8.74 tons of LDPE plastic, and pelletized 2.4 tons. We processed the total of 24.94 tons of plastic waste. This amount of 2.4 tons pelletized is due to the breakdown of our palletizing machines. The support from Julius Baer Foundation, we purchased a new set of palletizing machines which newly arrived in March 2022.

We produced the total of 13.453 geometric sets and 97.856 rubber cups from November 2020 to December 2021. We used 6.150 tons of collected plastic material to produce the rubber cups, while 1.345 tons of plastic waste was used to process geometric tools.







5.3 Multiplication / Replication Preparation

What preparatory work was carried out for the multiplication and replication within the project's framework?

The preparation work carried out for the multiplication and replication were as follows:

- We had meetings with stakeholders mainly city mayors of five cities: Paynesville, Ganta, Buchanan, Kakata, and Gbarnga City. During our meetings with these cities, we identified their disposal sites, got to know the local system of waste collection and disposal, met with business owners, Non-Governmental Organizations, and some residents to hear from them about the current approach in use for managing waste in their cities.
- We invited these mayors to Green Cities recycling center in Monrovia to show them our work and so they could get firsthand information on our activities.
- We worked on having a bigger recycling facility. We were able to purchase 1.1 acres of land for the construction of our recycling facility. The construction of this facility was achieved with support from REPIC and Julius Baer Foundation. Also the construction of a second facility for e-waste recycling right next to it sponsored by AECF helped to share some cots.
- To increase our production, we also worked with the Julius Baer Foundation to purchase a set of a plastic palletizing machine.
- To reduce the volume of plastic waste in storage, we signed a partnership agreement with Wildplastic GmbH from Germany to have some of our unprocessed plastic shipped to their partner in Portugal.

With these preparations, we believe we are prepared to replicate our project in these five cities and to also increase our production and impact through the increase in production and selling (for example to local rubber plantations), and the shipment of plastic when the need arises.

5.4 Impact / Sustainability

Which impacts were already noticeable up to the end of the project?

On a daily basis we created a big impact on the livelihood of youth and marked women who collected and sold to Green Cities.

The number of people brining plastics to our facility for sales has increased.

The number of Community Based Organizations calling us to pick up their big quantities of collection from within their various communities has increased.

We were able to train people in recycling techniques, build a committed team that went through all the economic and by the health-crisis caused difficulties, installed a production site, supported local communities in collecting their waste and setting up waste management systems, strengthened a network of stakeholders, produce customized products out of collected and processed plastic waste, win new customers who are greatly thankful for our unique products. These are only a selection of our achievements and only by knowing the local context can show the huge importance and impact this has.

We were able to construct a large plastic storage and recycling facility. This facility will help us to increase collection activities and to increase production. With the availability of a larger storage facility, we can increase the collection of plastic waste and other recyclables in various communities. This collection process is helping youth, women, scavengers, and Community Based Enterprises to generate income for livelihood opportunity.

Impact and sustainability are, therefore, on different levels: Starting by the people who can make a living, to the economic independence of this social business, and leading up to the reduction of our carbon footprint, that this intervention will contribute to greatly – with the volume of plastic waste collected daily.

Ecological	**Unit**	**At the REPIC Project's Completion**
Greenhouse gas reduction		131 tons
Newly collected and separated waste		250 tons
Newly recycled waste		25 tons
Economic		
Triggered third-party funding/investments	[CHF]	2019: 172,481 USD 2020: 108,994 USD 2021: 230,720 USD Total: 512,195 USD
Local private income generated	[CHF]	2019: 21,179 USD 2020: 5,755 USD 2021: 18,331 USD + 22,000 USD Total: 64,417 USD
Social		
Number of beneficiaries	[1.3 millions]	
Number of new jobs	[150]	
Number of trained personnel	[176]	

Other Indicators		
Indicator 1	[Unit]	
Indicator 2	[Unit]	
Indicator 3	[Unit]	

Note: This calculation is based on three years partnership with REPIC

6. Outlook / Further Actions

6.1 Multiplication / Replication

What are the next planned steps?

What is being done to promote multiplication / replication?

Which hurdles need to be overcome in order to have successful multiplication / replication?

Next planned steps:

Green Cities is an integrated waste management social enterprise. To have this social business fully sustainable, we will increase our activities in plastic, organic and electronic waste recycling.

- Establishing sub collection points in these cities within five years' period (2022-2026). The first two years (2022-2023) we will focus on two cities, Buchanan, and Paynesville, while the remaining years will focus on Ganta, Kakata, and Gbarnga.
- Have our new palletizing machines in Liberia to increase our production of palletized plastic to produce end products.
- Increase awareness to help us increase the number of people generating revenue through the collection and selling of plastic waste.

Additional Information about the size of these cities:

- **Monrovia** is the capital city of the West African country of Liberia. Founded in 1822, it is located on Cape Mesurado on the Atlantic coast, and is the country's most populous city. As of the 2008 census, with 1,010,970 residents, it was home to 29% of Liberia's total population. The Ordinary Least Square Regression (OLS) method estimates the average household waste per capita generation as 0.76kg. Based on the estimation, the estimated number of households in Greater Monrovia is 303,400. The projected waste produce annually is 421,968.8 tons. Of this volume, 43% represent organic, and 14% plastic. Monrovia is also the country's economic, financial, and cultural center. Its economy is primarily centered on its harbor and its role as the seat of Liberia's government. This city also hosts a sub city called **Paynesville** City.
- **Ganta**, also known as Gompa City, is a town approximately 323 kilometers from Monrovia in Nimba County of northern Liberia. It is located just south of the Guinea border. It is the second-most populous city in Liberia, with an estimated population of 41,106 as of 2008 (and has a population of 34,279.
- **Gbarnga** is the capital city of Bong County, Liberia, lying north east of Monrovia. During the first Liberian civil war, it was the base for Charles Taylor's National Patriotic Front of Liberia. Cuttington College, a private Episcopal-affiliated institution, is located near the town. Its campus was once home to the Africana Museum, which was destroyed during the civil war. According to 2008 Liberia Institute for Statistic and Geo-Information Services, Gbarnga has a population of 34,046. It is the fourth-most populous urban area in Liberia.
- **Kakata** is the capital city of Liberia's Margibi County and is located in Kakata District just over the Du River bridge which is its border with Todee District. It is a transit town at the heart of the historical natural rubber cultivation belt in Liberia. The city is colloquially known as "Kak City". As of the 2008 census, Kakata has a population of 33,945; it is the fifth most populous urban area in Liberia.

Cities	**Population**	**# Households**	**Waste volume per annual** (The Ordinary Least Square Regression (OLS) method estimates the average household waste per capita generation as 0.76kg)	**Waste Management situation**	**# Schools**	**# Rubber farmers**
Greater Monrovia (Including Paynesville)	1,517,000	303,400	421,968.8 tons	45% collected for disposal and recycling; 55% not handled	52 schools	No major rubber company located here but only smallholder farmers
Kakata	33, 945	6,789	1,888.4 tons	No Waste Management system in place	9	Firestone, Salala Rubber Corporation
Buchanan	34,270	6,854	1,909.5 tons	No Waste Management system in place	8 schools	Liberia Agricultural Company (LAC)
Ganta	41,106	8,221	2,286.75 tons	No Waste Management system in place	14 schools	Nimba Rubber Corporation
Garnga	34,046	6,809	1,880 tons	No Waste Management system in place	12 schools	No major rubber company located here but only smallholder farmers

Several things have been done to promote multiplication/replication:

- The purchased of a new set of machines to increase productivity
- The construction of a large storage facility
- Engagement with stakeholders for the replication of our project in additional five cities
- Training youths and other professionals in plastic, and electronic recycling, using Fair Recycling's online portal to help train professionals. This training also included 'Environmental Health' and 'Safety'.

To have a successful multiplication/replication, we need government intervention through national policy on waste recycling. This policy will help cities to be more responsible and this will reduce sorting because most people will start separating their waste at source. With this intervention, we can be able to increase our activities nationwide.

Projection analysis for the next 5 years

Source	**Activities**	**Turnover (saving) p. year**
Waste Collection Services	Waste collection services from 51 customers (businesses, NGOs, Government offices and Household.	**US$43,704.00**

<table>
<tr><th>Source</th><th>Activities</th><th>Turnover (saving) p. year</th></tr>
<tr><td></td><td>Businesses 21x$100.00x12 months =$25,200.00
NGOs 14x$75x12 months =$ 2,600.00
Government Agencies 16x$81.00x12 months =$15,552.00</td><td></td></tr>
<tr><td>Sale of other recyclables</td><td>
<table>
<tr><th>Items</th><th>Qty</th><th>U/Cost $</th><th>Total income</th></tr>
<tr><td>Aluminum Scrape</td><td>10 tons</td><td>750</td><td>7,500.00</td></tr>
<tr><td>Scrape Metals</td><td>22 tons</td><td>133.00</td><td>2,926.00</td></tr>
<tr><td>Scrape Copper</td><td>½ tons</td><td>6,000</td><td>3,000.00</td></tr>
<tr><td>Used Battery</td><td>1 ton</td><td>466.00</td><td>466.00</td></tr>
<tr><td>Scrape from Electronic waste</td><td>5 tons</td><td>750.00</td><td>3,750.00</td></tr>
<tr><td>Grand total income</td><td></td><td></td><td>$17,642.00</td></tr>
</table>
This calculation is based on the current market buying price locally (May 2022)
</td><td>US$17,642.00</td></tr>
<tr><td>Plastic Recycling</td><td>
<table>
<tr><th>Items</th><th>Qty</th><th>U/Cost $</th><th>Total income</th></tr>
<tr><td>Purchase of plastic from CBEs, water producers, community youths, and waste pickers by Green Cities</td><td>35 tons</td><td>$165.00</td><td>$5,775.00.00</td></tr>
<tr><td>Sale of Geometric tools to students</td><td>3,304 sets</td><td>$1.00</td><td>$3,304.00</td></tr>
<tr><td>Sale of Rubber latex collection cups</td><td>56,428 cups</td><td>$0.17</td><td>$9,592.76</td></tr>
<tr><td>Sale of Diesel from plastic waste. Produced through Pyrolysis</td><td>1210 gallons</td><td>$5.00</td><td>$6,050.00</td></tr>
<tr><td>Grand total income</td><td></td><td></td><td>$24,721.76</td></tr>
</table>
</td><td>US$24,721.76</td></tr>
<tr><td>Compost/ Organic fertilizer</td><td>
<table>
<tr><th>Product</th><th>Qty</th><th>U/Price</th><th>Total Income</th></tr>
<tr><td>Compost/Organic fertilizer</td><td>500 bags (50kg bag)</td><td>$15.00</td><td>$7,500.00</td></tr>
<tr><td>Grand total</td><td></td><td></td><td>$7,500.00</td></tr>
</table>
Note: The current Liberia market for compost/organic fertilizer not well developed due to limited equipment for processing. With experience gathered from other countries show that most compost manufacturing is mostly subsidized.
</td><td>$7,500.00-the benefit is considered from the positive impact on health of taking out organic waste from the environment. That cost is not included here.</td></tr>
<tr><td>Cost reduction</td><td>Low efficiency of City corporations in waste collection, transport and final disposal will be replaced by efficient Public Private Partnership:
status quo: 1 tons of waste costs USD 110.00 for collection, transportation and disposal in an open landfill.

With Green Cities intervention, collection, transportation will cost $22.00 per ton.</td><td>$2,200.00</td></tr>
</table>

Source	Activities	Turnover (saving) p. year
	With this project intervention, 25 tons of organic waste will cost $550 while direct collection and disposal of 25 tons of waste by city corporation cost $2,750.00 This intervention will reduce the cities spending by $2,200.00 by composting 25 tons	
Total value per annum		**US$ 95,767.00**

Note: This is increase by 5% annually

#	Description	Total Income
1	Year one income	$95,767.00
2	Year two income	$100,555.35
3	Year three income	$105,583.10
4	Year four Income	$110,862.30
5	Year five income	$116,405.40
6	**Grand Total**	**$529,173.15**

What needs to be done to increase productivity and self-sustainability as a social enterprise?

	Description	Qty	U/Price	Total	Status
	Additional Plastic processing machines				
	PPM-75E Extruder Machine with stand pelletizer (Water Tank, Control Panel, and Standard Palletizer)	1	37,200.00	37,200.00	Achieved
	PPM-100A Agglomerator Machine	1	$11,753.00	$11,753.00	Achieved
	PP-25HSM High Speed Mixer	1	$8,750.00	$8,750.00	Achieved
	Grand Total			**$57,703.00**	
	Outstanding machine for plastic pyrolysis				
	Pyrolysis machine (for the production of Diesel from plastic waste)	1	$37,850.00	$37,850.00	Not achieved
	Sub Total			**$37,850.00**	
	Machines for commercial Composting				
	Sieve machine	1	$18,500.00	$18,500.00	Not achieved
	Shredder	1	$15,230	$15,230	Not achieved
	Front loader	1	$39,600	$39,600	Not achieved
	Collection van	1	$27,500	$27,500	Not achieved
	Sub Total			**100,830.00**	
	Waste Collection				

	Mini waste collection Trucks				
	Door-To-Door Solid waste collection	2	$37,540.00	$75,080.00	Not achieved
	Sub Total			**$75,080.00**	
	Grand Total			**$213,760.00**	

With the above investment, below is the growth projection of the project

<table>
<tr><th>Source</th><th>Activities</th><th>Turnover (saving) p. year</th></tr>
<tr><td>Waste Collection Services</td><td>Waste collection services from 154 customers (businesses, NGOs, Government offices and Household.
Businesses 78x$100.00x12 months =$93,600.00
NGOs 36x75x12 months =$32,400.00
Government Ministries and Agencies 40 x$81.00x12months =$38,880.00</td><td>US$164,880.00</td></tr>
<tr><td>Sale of other recyclables</td><td>
<table>
<tr><th>Items</th><th>Qty</th><th>U/Cost $</th><th>Total income</th></tr>
<tr><td>Aluminium scrape</td><td>21.4 tons</td><td>750</td><td>15,300.00</td></tr>
<tr><td>Scrape Metals</td><td>39 tons</td><td>133.00</td><td>5,187.00</td></tr>
<tr><td>Scrape Copper</td><td>1.2 tons</td><td>6000</td><td>7,200.00</td></tr>
<tr><td>Used Battery</td><td>2.3 tons</td><td>466.00</td><td>1,071.00</td></tr>
<tr><td>Scrape from Electronic waste</td><td>6.4 tons</td><td>750.00</td><td>4,800.00</td></tr>
<tr><td>Grand total income</td><td></td><td></td><td>$33,558.00</td></tr>
</table>
This calculation is based on the current market buying price locally (May 2022)</td><td>$33,558.00</td></tr>
<tr><td>Plastic Recycling</td><td>
<table>
<tr><th>Items</th><th>Qty</th><th>U/Cost $</th><th>Total income</th></tr>
<tr><td>Purchase of plastic from CBEs, water producers, community youths, and waste pickers by Green Cities</td><td>35 tons</td><td>$165.00</td><td>$5,775.00.00</td></tr>
<tr><td>Sale of palletized plastic</td><td>35 tons</td><td>$1250.00</td><td>$43,750.00</td></tr>
<tr><td>Sale of Geometric tools to students</td><td>3,304 sets</td><td>$1.00</td><td>$3,304.00</td></tr>
<tr><td>Sale of Rubber latex collection cups</td><td>56,428 cups</td><td>$0.17</td><td>$9,592.76</td></tr>
<tr><td>Sale of Diesel from plastic waste. Produce through pyrolysis</td><td>8540 gallons</td><td>$5.00</td><td>$42,700.00</td></tr>
<tr><td>Grand total income</td><td></td><td></td><td>$99,346.76</td></tr>
</table>
</td><td>$99,346.76</td></tr>
<tr><td>Compost/ Organic fertilizer</td><td>
<table>
<tr><th>Product</th><th>Qty</th><th>U/Price</th><th>Total Income</th></tr>
<tr><td>Compost/Organic fertilizer</td><td>3826 bags (50kg bag)</td><td>$10.00</td><td>$38,260.00</td></tr>
</table>
</td><td>$38,260.00-the benefit is considered from the positive impact on health of taking out organic waste from the environment.</td></tr>
</table>

Source	Activities	Turnover (saving) p. year
	Grand total | | | **$38,260.00** Note: The current Liberia market for compost/organic fertilizer not well developed due to limited equipment for processing. With experience gathered from other countries show that most compost manufacturing is mostly subsidized.	That cost is not included here.
Cost reduction	Low efficiency of City corporations in waste collection, transport and final disposal will be replaced by efficient Public Private Partnership: status quo: 1 tons of waste costs $US110.00 for collection, transportation and disposal in an open landfill. With Green Cities intervention, collection, transportation will cost $22.00 per ton. With this project intervention, 191.3 tons of organic waste will cost $4208.6 while direct collection and disposal of 191.3 tons of waste by city corporation cost $191,300.00 This intervention will reduce the cities spending by $18,7091.4 through composting 191.3 tons	$18,7091.4
Total value per annum		**US$523,136.2**

Note: This is increase by 5% annually

#	Description	Total Income
1	Year one income	$523,136.20
2	Year two income	$549,293.00
3	Year three income	$576,757.65
4	Year four Income	$605,595.55
5	Year five income	$635,875.30
6	**Grand Total**	**$2,890,657.70**

6.2 Impact / Sustainability

What are the expected sustainable effects (environmental, socio-economic aspects, CO2 relevance, resource efficiency, etc.)?

The "Plastic Recycling Project – Monrovia" reduces environmental pollution through the proper collection, transportation and recycling of post-consumer and post-production plastic waste collected from various communities. This project also reduces diseases by reducing the increase in flies, cockroaches, mosquitoes, and rats.

With our continuous intervention, this project is creating jobs for youth and women. Most of these jobs will be created through the support of the establishment of more Community Based Enterprises. With these networks, we will have more jobs created because they are easily accessible also for people who can't afford to travel outside their community. Secondly, we will have market women having their collection points for income generation.

The carbon footprint for plastic is: 1kg of plastic that is recycled helps to safe our planet from 6kg of CO2 emission (source: Carbon Footprint of Plastic | Stop Plastics; stopplastic.ca/carbon-footprint-plastic). Regular statistic will be taken on the volume of waste collected daily.

To have resource efficiency, we will make sure from now on quality equipment is purchased for our recycling activities. Unlike our previous palletizing machine: It was bought from China and secondly it was a lower grade. We trusted a local supplier to help but their partner in China was not honest to us about the quality. To avoid this, we did research in other African countries and came across a company in Rwanda called EcoPlast. The manager of this company connected us to the supplier of his machines. This helps us to order good quality machines. Same will be done to other materials that will be purchased for the work we do.

7. Lessons Learned / Conclusions

What are this project's main findings and conclusions?

Which recommendations can be made for similar projects, or within this context?

Interesting observations within the project's context: Which of your personal impressions would you like to share?

The projects main findings are as follows:

- Due to the lack of national policies on waste management, open dumping has always affected recycling activities with more people not willing to properly handle their waste.
- This project helped more people to know the importance of waste as valuable resource.
- The project helped more youths and women to get livelihood support through the collection and selling of collected recyclables.
- This project helped to build our practical knowledge in plastic recycling.
- This project built our network and connected more stakeholders around Green Cities recycling activities and goals.
- We learned that substandard equipment is in the long-term much more expensive. This has to do with high cost relating to maintenance, and productivity is very slow and not effective.
- Waste is no longer viewed as a disposable item. It is considered to be an income-generating source for underprivileged.
- More and more businesses / customers are interested in our products and want to partner with us.
- Plastic recycling is a large field, with many requirements and challenges to overcome, and it's difficult to be a pioneer in an economically and infrastructurally unstable context.
- To implement such a project, one needs a strong partnership, a committed team, many local networks, and good support.

To conclude, this project helps to reduce the carbon footprint, create livelihood opportunity for youth and women, reduce the volume of waste going into our landfill, and helps national government to think about having a national policy on waste value chain.

For someone wishing to venture into plastic recycling:

- They need to be open minded. This means, willing to learn about other approaches used in plastic recycling. This research will help you avoiding to waste time with the project.
- It's important to study the psychological situation of his/her clients. Most of the people who supply us recyclables, suffer from Post-Traumatic Stress Disorder (PTSD). This means, some of our suppliers are ex child soldiers who have become men, youths whose parents cannot afford to provide

their daily needs, single mothers mainly widows, etc.

- One needs to understand the waste composition of where the project is expected to commence. This will help said person to have some knowledge on the volume and types of plastic disposed daily. Knowing the type and volume of plastic, helps you to develop your intervention methodology.

My, James, personal impressions I would like to share are as follows:

- The family line built at Green Cities due to teamwork. Working as a team has helped us greatly to be involved with each other.
- The relationships built with youths and women who saw themselves neglected by society.
- The transformation in the lives of youths and women as a result of this project.
- National and International recognitions we have received because of this project.

8. References

References list of publications, reports, etc.

9. Annex

When available: Reports, press articles, brochures, test results, etc.

Please include **photos**, easily comprehensible graphics, etc., with this report.

Please send the complete final report directly to: info@repic.ch
(REPIC Sekretariat, c/o NET Nowak Energie & Technologie AG, Waldweg 8, CH-1717 St. Ursen)

Plastic Collection






Processing at Green Cities


Production of customized cups for the rubber industry

The building on the left: The storage facility constructed for plastic collection and further processing.

Green Cities Team, December 2021