

# Plastic Waste Recycling Heroes

Insights & case studies from  
African entrepreneurs



Sophie van den Berg  
February 2022

This research and publication has been realised under the project EJOM

Young people in Mali often lack decent employment opportunities, leading to high levels of unemployment. Funded by the European Union, a consortium of ICCO, WASTE, APEJ, led by SNV, is implementing the Value Chain Development and Youth Employment in Mali (EJOM) project. The project takes place in the four regions of Kayes, Koulikoro, Gao and the district of Bamako, all areas where young Mali people face systemic employment challenges. WASTE's interventions in the project focusses on setting up small businesses in solid waste management and improving existing ones to help them to grow and create employment.

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February 2022

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## Acknowledgements & introduction

## Acknowledgements

As part of the fight against irregular migration, the European Union has set up an Emergency Trust Fund for the regions of the Sahel and Lake Chad, the Horn of Africa, and North Africa with a view to help stimulate economic development and social stability by creating employment opportunities for young people, women and return migrants. It is in this context, that the EJOM project (Youth Employment Creates Opportunities, here in Mali) was funded by the EU, for a period of five years (June 2017 – Dec 2022). The project is implemented in the regions of Kayes, Koulikoro, Gao and the District of Bamako by a consortium of four organizations that are APEJ, ICCO, WASTE and SNV, which ensures the lead.

Project activities specifically contribute, among other things, to promoting the creation and / or development of 400 SMEs in the sectors of horticulture, agri-food, utility crafts and waste management. It is about creating successful micro, small and medium-sized enterprises, creating jobs for the benefit of young people. To do this, the EJOM project provides financial facilities to young project leaders or to existing businesses in the form of grants, non-refundable and without financial compensation. These are granted in cascade and are based on the results or performance of the companies that benefit from them. The facilities granted by the project are aimed at creating or strengthening the business, creating jobs, increasing the financial and management performance of the business. To monitor, evaluate and document these performances, the project has set up a monitoring-support and evaluation system for its beneficiary companies.

This report aims to show that financial and content support can give young entrepreneurs a chance to achieve their goals in becoming a growing enterprise. Our gratitude goes to our plastic waste recycling heroes: Oumar, Kevin and Mamadou for dedicating their time and sharing their experience and knowledge with us.

## Introduction

Plastic waste pollution is recognized as one of the major challenges that need to be solved to protect our oceans and living environment. This pollution largely originates from rapidly urbanizing areas throughout the developing world. We must fight plastic pollution in collaboration with cities in these areas. Furthermore, plastic pollution affects public health as the concern about microplastic and the increased risk of particles entering food chains is growing.

Waste management is an emerging issue in many cities worldwide. Due to rapid urbanization and economic development, the amounts of solid waste continue to increase and the growing presence of plastic in this waste can take up more than 10% of the total waste nowadays. Solid waste and more specifically plastic waste is becoming a major headache for waste management officials struggling to implement an affordable and effective waste management system suitable for their city. To name some of the challenges: lack of affordable and appropriate solid waste collection systems, fragmented value chains, a dysfunctional private sector, no affordable solution for low grade plastic waste and finally a lack of access to finance to support sustainable waste management.

Globally only 15% of the generated plastic waste is recycled and this concerns often only the easy to recycle plastic such as PET, HDPE and PP. In its almost 40 years of existence, WASTE supports recycling of plastic waste in the transition of a linear economy to a circular economy, to keep plastics longer in the loop. We identify the entrepreneurs with viable business ideas and support them with technical know how and linkages to equipment suppliers and possible finance. In this way we facilitate growth from the start up to early venture and growing business.

The aim of this publication is to disseminate lessons learnt from the support of three entrepreneurs in Africa: Oumar in Mali, Kevin in Kenya and Mamadou in Senegal, our plastic waste recycling heroes. We analyse their business in detail: *Why are they successful and what challenges did they encounter and still need to overcome?* On a higher level, we look at this collection of insights on plastic recycling and exploring key questions about accelerating plastic recycling as part of the circular economy on the continent. It looks at the potential of plastic recycling in the waste sector across the continent and highlights existing practices.

This publication shows what lessons and inspirations can be drawn from these practices, rather than offering specific solutions or recommendations. It also covers the opportunities in terms of economic development and job creation, and the wider social and environmental benefits. This report focusses on the individual stories that need to be told and the lessons and inspirations that can be drawn from them. Oumar, Kevin and Mamadou are our circular economy trailblazers that demonstrate new circular business models, encourage innovative partnerships and knowledge-sharing and are an example for many young people in Africa who also aspire to start a business in plastic recycling. Their success represents a great and exciting potential for African countries and their young people.





## Case study 1: DGB Plastique SARL, Oumar Lamine Diaby (Bamako, Mali)

*DGB Plastique SARL recycles plastic into tubes for electricity and network cables offering the construction industry a local, cheaper, and high-quality alternative to the imported tubes.*

**Environmental:** Since start of the factory DGB has recycled 100 tonnes of plastic waste preventing this from ending up in the environment or being burnt

**Economic:** DGB provides direct jobs to 20 employees (15 men and 5 women) and indirect jobs to 50-100 waste pickers

**Social:** Stable income for 20 workers and additional income for 50-100 waste pickers



# 1. Case study 1: DGB Plastique SARL, Oumar Lamine Diaby (Bamako, Mali)

## 1.1. Key characteristics

Name of enterprise:	DGB Plastique SARL
Owner:	Oumar Lamine Diaby
Location:	Sogoniko Commerciale 126, Bamako (Comune VI)
Plastic waste input materials:	Hard plastic (HDPE, PP), soft plastic (LDPE)
Product:	Green electricity tubes
Year of establishment:	March 2017
Present capacity:	12,000 rolls of PE sheath tubes (100 m) per year
Workers employed:	20 workers, 5 women and 15 men
Initial investment:	265.000 Euro
Yearly turnover:	200.000 Euro

## 1.2. The entrepreneur's story

DGB Plastique was established in March 2017, with the aim to recover and recycle plastic waste and to train young people in the field of recycling plastic waste. The owner of DGB, *Mr. Oumar Lamine Diaby*, a 100% shareholder, acquired his first experience in working with plastics at his father's plastic manufacturing company before launching his own factory. Oumar saw the potential of using recycled plastic and introduced this in his father's factory. His father has more than 25 years of experience in producing plastic products and manufactures water kettles for the local market, using recycled plastic.

Oumar lived in France and Spain as a professional football player, at the end of his career he followed a course on plastic recycling in Spain for two years. This training course facilitated him with the technical skills and knowledge to return to Bamako and start recycling plastics in his own factory and offering his contribution towards diminishing the plastic waste pollution problem in the capital city of Mali.

Although Oumar was not one of the beneficiaries of the EJOM programme, he is a good example for the young and upcoming entrepreneurs in Mali.

## 1.3. Technology, sourcing of raw materials and utilities

At present, the main activity of DGB Plastique is to recycle HDPE plastic waste into tubes which are used in the construction sector. For this purpose a PE tube extrusion line was purchased from China with a maximum capacity of 400 kg/hr and another tube making machine with capacity of 250kg/hr. These tubes are used in construction buildings to guide and protect electricity wires.

Plastic waste is sourced from waste pickers, waste collection enterprises (GIES), scrap dealers (BNSS) and USAID. The plastic waste is grinded, washed, dried, and converted into tubes. Next to the extrusion line, DGB Plastique owns four shredders. DGB Plastique employs 20 workers, 5 women and 15 men. The power supply is sufficient for the presently installed equipment, except for the power drops or surges. To diminish the consequences DGB has installed a so-called 300 kVA stabilizer. A bigger problem is caused by the power cuts, these occur regularly, especially in periods of great heat (March, April, and May). DGB uses a bore hole (180 meter deep) on its own premises for their water usage. In addition there is a water tank of 300-500 litre on the site. Water is used for the washing of plastic waste and for cooling of the end products.



Figure 1 The present tube extrusion line (source: Seydou, April 2021).

#### 1.4. Marketing



Figure 2 Logo DGB Plastique SARL.

Most electricity tubes are not manufactured in Mali but are imported from Côte d'Ivoire, Senegal, Togo, Nigeria, and China. The aim of DGB is to replace these imported tubes by locally produced tubes out of recycled plastic. DGB will guarantee that these tubes have the same quality and are cheaper as the imported tubes.

The construction sector and the agricultural sector are both constantly growing in Bamako because of increased population, ensuring a fierce demand for electricity tubes and irrigation tubes. Import of virgin resin to produce these tubes has become very costly. The inhabitants of Mali will not buy recycled products out of environmental awareness as is the case in Europe. Mali is among the poorest countries of Africa and on top of this it is a country in conflict. People struggle to earn their daily living. Awareness about plastic waste pollution and its effects are very low.

### 1.5. The business case: Cost-benefit analysis

Cost-benefit analysis is a process used primarily to weigh the sum of the benefits, the income of an enterprise, against the negatives, or costs, of that enterprise. Annex 1 gives some detailed information about the business case of producing tubes out of plastic waste in Senegal, but the process is the same as the process of Oumar in Mali. Looking at the costs, the table in annex 1 shows that raw materials are an important cost item for the factory because a certain quality of material is needed: clean shredded HDPE of a certain size. Because of this Oumar shreds and washes his plastic waste to lower costs of raw material and to be able to control the quality. With an investment of €36,000 (equipment from India) the business case shows that this investment could be paid back in 1.3 years. A very interesting proposition. Margins are good, there is a 30-45% profit margin.

### 1.6. Enabling environment

DGB states to have all permits in place but experiences no further support by the commune VI. The municipality of Commune VI is not involved in the enterprise via their solid waste strategy, so his activities are fully depending on the market. A strong point of Oumar is that he knows how to attract foreign partners such as SNV, USAID and CORDAID. DGB has a contract with USAID to recycle its empty pesticide containers with required safety and environmental measures in place. He has recently applied for an investment loan with Cordaid Investment Management. This application was honoured with a loan which enabled him to buy a new extrusion line to increase its capacity.

### 1.7. Impact: Socio-economic, health and environment

DGB Plastique Mali Sarl currently employs 20 permanent employees in its factory in addition to waste pickers who collect plastic. The number of indirect jobs vary from 50 to 100 people across the different communes of Bamako.



Figure 3 The green recycled tubes of DGB.

Protective gear is present at the factories premises and employers are instructed to use them. Since the beginning of the enterprise, DGB has already recycled 100,000 kg of plastic, and trained more than 150 young people, including 50 young inmates of the Bamako Central Jail.



### 1.8. Innovation

Oumar has an innovative mind, as can be seen in his own built extruder, water cooling system and plastic washing system (see picture below).



Figure 4 Washing system of big items of plastic waste.

### 1.9. Access to finance

Oumar states in the interview that In Mali it is nearly impossible to obtain a loan from a local bank and this hampers growth of the plastic recycling sector. Fortunately, Oumar managed to attract the attention of Cordaid Investment Management (CIM). The investment manager of CIM monitored the activities of DGB for two years and based on the positive impression decided to help the company develop their financial policies and procedures. Cordaid Investment Management supported DGB with a pre-investment grant to develop a robust business plan, audit accounts and introduce Environmental and Safety Governance (ESG) documentation. CIM: "The implementation of the grant gave us enough ground to start an investment process. Our confidence in Oumar and his company allowed him to think big about the business. His ambition is genuinely to be the largest plastic waste processing centre in West Africa." In this process CIM contracted WASTE to support their due diligence process with technical knowledge.





## Case Study 2: Ecoblocks and tiles, Kevin Mureithi (Gilgil, Kenya)

In 2015, Kevin Mureithi visited WASTE's office to present his idea to make roofing tiles out of plastic waste. As of 2021, Kevin is the proud owner of a factory where 70,000 roofing tiles per month are being produced and 8 young people have a job.

*"We are a mission-driven company with two agendas: First, to supply home builders with premium building products that make their houses stylish and unique. Secondly, and close to our hearts, we are consciously working to reduce environmental pollution caused by plastic waste by recycling these into distinct building materials that are aesthetically appealing, longer lasting and affordable". -Kevin Mureithi*

### Enterprise

**Environmental:** Since start of the factory Ecoblocks and tyles has recycled 350 tonnes of plastic preventing this from ending up in the environment or being burnt

**Economic:** Ecoblocks and tiles provides direct jobs to 8 employees and indirect jobs to 12 waste pickers

**Social:** Stable income for 8 young workers in the rural area and additional income for 12 waste pickers

## 2. Case study 2: Ecoblocks and tiles, Kevin Mureithi (Gilgil, Kenya)

### 2.1. Key characteristics

Name of enterprise:	Ecoblocks and tiles ( <a href="http://www.ecoblocksandtiles.co.ke">www.ecoblocksandtiles.co.ke</a> )
Owners/founders:	Kevin Mureithi and Hope Mwanake
Location:	Gilgil, Kenya
Plastic waste input materials:	Hard plastic (HDPE, PP), soft plastic (LDPE)
Product:	Roofing tile in 4 colours: green, red, black, brown
Year of establishment:	2016
Present capacity:	70,000 roofing tiles per month
Workers employed:	20 people including 8 in the production side
Initial investment:	150,000 US\$



Figure 5 A roof being built with Ecoblocks and tiles.

### 2.2. The entrepreneur's story

In 2012, Kevin Mureithi and Hope Mwanake (both alumni of UNESCO IHE, Delft, The Netherlands) founded the social enterprise, Trace, to collect waste from households in Gilgil after being frustrated by the ever-increasing littering of waste in the community. Their primary business entailed waste collection from residents and subsequent disposal at the local council's disposal site and this helped clean the neighbourhood. From these waste management activities Kevin discovered the need for recycling plastic waste and started to explore ideas about converting plastic waste into roofing tiles.

In 2016, Kevin started his plastic waste recycling enterprise in Gilgil with the aid of the Dutch [VIA Water](#) program. After five years of being in business he can say: "This is my fifth year working at the company I founded to make great products from recycled plastics. We have recycled tons of plastics, created a local guaranteed buying market



for waste pickers in Kenya and managed to convince a rather rigid building industry to use construction materials made from recycled materials.”

### 2.3. Technology, sourcing of raw materials and utilities

*Ecoblocks and Tiles* buys and collects plastic waste and turns it into a high-quality product, roofing tiles, that can be used to create roof tops for houses. Upon collection, the production process entails three steps: firstly the grinded plastic waste is mixed with sand in a cement mixing device, the sand is collected from riverbeds. A magnet is used to take out metal parts that might be present. Secondly the mixture is melted in an extruder. The melted mixture that comes out of the extruder is weighed and placed in the press. The press can produce 6 roofing tiles in one time. After cooling down the roofing tile is ready. The machines are purchased from South Africa. *Ecoblocks and Tiles* collects plastic waste (10%) and sources the other part of the raw material from waste pickers and scrap dealers. The process needs electricity to run the machines and water to cool the mould with the product.



Figure 6 The press can produce 6 tiles at once.

### 2.4. Marketing



Figure 7 Ecoblocks + tiles logo.

Through promotions in fairs, events, and social media posts, *Ecotiles* is attracting homeowners and small businesses to expand demand and ensure an ever-increasing impact of this innovative method of ecological construction which also allows to reduce deforestation. The company can deliver the plastic recycled tiles all over Kenya. The roofing tiles are new on the Kenyan market. Compared to traditional options, this product offers cost savings of up to 40% because they are light replacing the need to use expensive reinforced timber and making installation much quicker. They are also hard to break and hence clients to do not pay for unnecessary breakages during transportation and roofing.

Different types of clients require different sales strategy. “Understanding this about our various clients was crucial for us and we modified our approach to suit them differently. We now know what keeps a smile on each of our clients face and what we need to do to win more of them”. Due to the COVID crisis, the market was down but it is picking up again. Especially in the Western region of Kenya, clients are keen to install a roof made of plastic



Figure 8 Kevin at "The Biggest Home Show" fair in Nairobi.

roofing tiles. The market is still niche—the common public does not know the product which makes people hesitant to buy the roofing tiles. Now, the clients are mainly conscientious individuals in the Kisumu region. Still with the improving market, there is great potential to increase sales with clients such as housing contractors, governments, and international organisations. In September 2021 Kevin took part in a construction fair “The biggest Home Show” in Nairobi to promote his roofing tiles.

## 2.5. The business case: Cost-benefit analysis

Cost benefit analysis is a process used primarily to weigh the sum of the benefits, the income of an enterprise, against the negatives, or costs, of that enterprise. Annex 2 gives some detailed information about the business case of producing bricks out of plastic waste which is a similar process to the roofing tile production. The roofing tiles sell for a price of a KSh120 per tile (US\$1.10). But Kevin is operating in a difficult market that needs to be developed. Therefore benefits are difficult to predict as the roofing tiles are produced on order basis. The example in Annex 2 shows a payback time of 5 years, still an interesting business case. Looking at the costs, the table in annex 2 shows that electricity is an important cost item for the factory.

## 2.6. The enabling environment

Kevin started his company with a start-up grant from the VIA waste programme from The Netherlands which also provided him with technical assistance support from WASTE. The company has also gained support from the Kenyan Government, which is promoting the use of sustainable greener materials as part of its efforts to reduce carbon emissions generated from the construction industry. The factory holds a certificate of the Kenya Bureau of Standards which allows Kevin to sell the tiles on the Kenyan market. The current increasing environmental awareness in Kenya is helping Kevin in the promotion of his product and he uses this momentum in his marketing



strategy. Kevin was supported by the county government by not charging for a trade licence and promoting the tiles. The county demonstrated the use of the roofing tiles by buying them and also promoted the roofing tiles in exhibition fairs.

## 2.7. Impact: Socio-economic, health and environment

To date, the company has provided roofing to 70 homes around the country and provided jobs to 15 young people in a rural area where unemployment is high. A typical 3-bedroom house will consume at least 1.5 tonnes of plastics that would otherwise have ended up in the environment. Next to direct employment Ecoblocks and tiles provides indirect employment opportunities to informal waste pickers who are the key suppliers of the input material. When doing some calculations you can state that of each house tiled with Ecotiles, 50 Informal workers earn each US\$5. (The raw material costs for a roof is US\$250).

## 2.8. Innovation

Making roofing tiles out of a mixture of plastic waste and sand is not a new process. Several factories across the world are known to use the same process such as Resintile in Uganda and Polysand in Canada. But the introduction of these roofing tiles and the demand creation that was needed to sell the product shows the innovative character of this technology in Kenya.

## 2.9. Access to finance

Ecoblocks and tiles started with seed funding from the Dutch VIA water program which enabled Kevin to buy the equipment. He used his savings to build a hangar. In addition to this seed funding, Kevin and his partner, Hope, were able to win several challenges and prizes to be able to expand their process.



### Case study 3: Developpement Materiels Synthetiques (DMS), Mamadou Diaw (Thiès, Senegal)

*Mamadou Diaw was born in Thiès, Senegal but studied and worked in France and Italy. After his return to his birth ground, he founded DMS in 2015 to use what he had learnt about plastic recycling in Italy. Mamadou invested all his savings in second hand plastic recycling machinery which he imported from Italy. He started with the production of PVC tubes in 2015 but shifted to recycled PE tubes and using recycled material.*

#### Enterprise

**Environmental:** Since start of the factory DMs has recycled 800 tonnes of plastic preventing this from ending up in the environment or being burnt.

**Economic:** DMS provides direct jobs to 16 employees (10 women and 6 men) and additional income to numerous waste pickers

**Social:** Stable income for workers and additional income for waste pickers

### 3. Case study 3: Développement Matériels Synthétiques (DMS), Mamadou Diaw (Thiès, Senegal)

#### 3.1. Key characteristics

Name of enterprise:	DMS ( <a href="http://www.dmssenegal.com/">http://www.dmssenegal.com/</a> )
Owners/founders:	Mamadou Diaw
Location:	Dixième Riaom zone industrielle Thiès, Senegal
Plastic waste input materials:	Hard plastic (HDPE, PP), soft plastic (LDPE)
Product:	Orange electricity tubes and black water tubes for irrigation purposes, complete irrigation systems
Year of establishment:	2015
Present capacity:	1,000 kg per day
Workers employed:	16 workers (10 women, 6 men), 50 women in sorting
Initial investment:	€150,000
Yearly turnover:	€150,000

#### 3.2. The entrepreneur's story

Mamadou Diaw is Senegalese and spent more than 15 years in Italy, working first in the metal industry and eventually in the plastic industry. Around 2014, Mamadou decided to return to Senegal with his half-Italian family, because he wanted to contribute to sustainable development in his homeland and he believed he could provide a better life for his family in Senegal. Mamadou invested all his savings in second hand plastic recycling machine which he imported from Italy. With the intent of establishing a plastic recycling company, he started with the production of PVC tubes in 2015. PVC, however, is a difficult and polluting product to make and Mamadou abandoned this production once he came to realize that there were better margins to be achieved when producing PE tubes for drip irrigation systems. Furthermore recycled PE is easier to acquire in Senegal, and recycled PE tubes are easier to produce than PVC tubes.

#### 3.3. Technology, sourcing, and utilities



Figure 9 Irrigation kits sold as complete package

The recycling site is situated in Thiès. At present, the main activity of DMS is to recycle HDPE plastic waste into tubes which are used in the construction sector. For this purpose a second-hand PE tube extrusion line was imported from Italy with a maximum capacity of 5800 metres in 8 hours. A so-called sheath tube extrusion line, an iron wire is extruded together with the plastic. These tubes are used in construction buildings to guide and protect electricity wires. Next to these electricity tubes, Mamadou produces water irrigation tubes that can be used for drip irrigation systems.

Plastic waste is sourced from waste pickers, from schools and from the municipality. DMS educates women to sort and wash manually the plastic waste. Next to the extrusion line, DMS owns one shredder. DMS employs 16 workers, 10 women and 6 men.

Mamadou has an arrangement with the municipality that he receives one truck load (30 tons) of plastic waste at his premises every week. He trained 50 women to sort and to wash this plastic material to extract clean LDPE and HDPE from it. He uses this as raw material to produce tubes. The reject material, dirty and other types of plastics, are passed on to a business that produces paving tiles. For DMS, electricity is not a problem, over the last 2 years hardly any power cuts occurred. DMS is using quite some water to wash sorted plastic waste and to cool down the tubes. He installed a water-cooling system.



### 3.4. Marketing



Figure 10 Logo, DMS

DMS has been active on the market for 4 years now and has built trust with its customers. DMS states that they can provide the same quality of tubes as the European quality tubes for a lower price. DMS is Senegal's first and only producer of drip irrigation systems, made of 100% recycled plastic. Horticultural markets are expanding as Senegalese realize the importance of local agriculture. DMS main export canal is to Mali via Djibouti. Mamadou estimates that at least 30% of his production ends up in Mali through one of his distributors. In his new hangar he will have better quality equipment and a dust-free working environment. This will enable him to produce irrigation tubes for horticulture as these require a higher quality and small holes for drip irrigation.

Facebook: <https://www.facebook.com/www.dmssenegal>

Video: <https://www.facebook.com/dmsthies/videos/1792697120842061>

### 3.5. The business case: Cost-benefit analysis

Cost-benefit analysis is a process used primarily to weigh the sum of the benefits, the income of an enterprise, against the negatives, or costs, of that enterprise. [Annex 1](#) gives some detailed information about the business case of producing tubes out of plastic waste. Mamadou has proven that he can sell everything he produces so we can calculate the income of the factory based on this. Mamadou operates in an attractive market. Looking at the costs, the table in annex 1 shows that raw materials are an important cost item for the factory because a certain quality of material is needed: clean shredded HDPE of a certain size. Because of this Mamadou invested in training women to sort plastic waste to obtain a better quality of plastic waste for his factory. With an investment of €36,000 (equipment from India) the business case shows that this investment could be paid back in 1.3 years. A very interesting proposition. Margins are good, there is a 40% profit margin per tube of 400-500 meter.

### 3.6. The enabling environment

Mamadou has partnered up with national NGOs such as LVIA but also international partners such as Deltares, Aqua for All, WASTE, GIZ and Weterings Plastics from The Netherlands. He started with a second-hand machine from Italy but is now expanding with financial support of GIZ. Mamadou also participates at awareness creation activities on schools and at fairs.

### 3.7. Impact: Socio-economic, health and environment

DMS trains and educates women, children and students about plastic waste issues and plastic recycling. He supports schools by placing a device in the shape of a fish (see picture) to collect plastic waste. The plastic waste from the school is collected but children are also stimulated to bring plastic waste from their homes to the school.



Figure 11 (L) Creative bin for plastic waste. (R) Mamadou educates students in plastic waste management.



### 3.8. Innovation

DMS is expanding with a new hangar and new machines. The next extrusion line will be able to produce 8000 meters in 8 hours. Also, secondhand machines from The Netherlands have been purchased that will enable DMS to produce the drip irrigation accessories themselves instead of importing them from Italy. Mamadou is always searching for new innovations that makes the processes in his factory easier and more profitable. DMS is aiming for a growth of 20 percent turnover each year to stay sustainable and will keep innovating.

### 3.9. Access to finance



Figure 12 DMS's new hangar.

Mamadou started his enterprise buying a second-hand plastic recycling machine, but he managed to attract financial support from various foreign partners: VIA Water programme, Weterings plastic, and GIZ. Recently he obtained funding to construct a new hangar and expand his factory.



## Analysis

## 4. Analysis: Business conditions of plastic waste recycling enterprises

Plastic recycling enterprises are not executing stand alone activities but operate within an enabling environment (ecosystem). This enabling environment is a complex system of interconnected stakeholders, and many issues are involved. We adapted the entrepreneurial ecosystem framework from SEED<sup>1</sup> to our **Business Conditions Framework**, see figure 14. The purpose of this chapter is to describe comprehensively the framework based on our insights from the studied enterprises and identify the key challenges and corresponding interventions to make plastic waste recycling enterprises start, grow and flourish.



Figure 13 Business conditions framework

### 4.1. Dedication of the entrepreneur (mind set, skills, talent, perseverance)

Making a plastic recycling business a profitable business in a low- or middle-income country, is not an easy one. It requires from the entrepreneur that he has dedication, passion and an entrepreneurial mind set. Oumar, Kevin and Mamadou have this business mentality, meaning that they not only see opportunities but also have the skills to make them happen. In addition to this it takes time and dedication to make the business a success, to go through the different stages of idea, early market entry, development (scale-up) and growth (later stage) requires perseverance to cope with challenges and drawbacks and motivation to establish a successful enterprise.

This entrepreneurial mind set is not always accompanied by a sense for details: having a perfect administration in order and a company that looks clean and neat. We have seen this with quite some entrepreneurs and because of this they often lack financial track record which hampers them to obtain additional loans and to grow.

Technical skills are important, all three entrepreneurs show these skills and have received technical training related to plastic recycling equipment, trouble shooting and innovations. They also show that they are ambitious, setting goals within their reach and bringing their enterprise to growth. It is not only about technical skills, but motivation also comes from serving a higher purpose. All three indicate that seeing all the plastic bags everywhere and other plastic waste polluting their countries, they became frustrated and motivated. They entered this business not only to make money but to make the earth a better place, cleaner and to combat plastic pollution.

<sup>1</sup> From Waste to Resource: Policy Pathways for Eco-Inclusive Enterprises in South Africa, SEED Sectoral Business Condition Brief, June 2018.

## 4.2. Technology, sourcing, and utilities

Technology to produce recycled products such as roofing tiles and tubes is not readily available in Africa and needs to be imported from Asia or Europe. This makes the first investment to start a plastic recycling enterprise costly. Mamadou started with a second-hand machine, Oumar started with his own fabricated machine. All three analysed enterprises show that it is practical and advisable to start with robust machinery with low capacity and machinery that requires low maintenance.

Stable and affordable electricity is a key input to the feasibility of these type of enterprises. Extruders are known to consume high amounts of power especially during start up of the daily production. This can be a severe bottle neck as electricity can be very expensive in certain countries or be very irregular varying from power surges to power cuts. These challenges are not easy to solve. In some countries other sources of energy are used to melt the plastic such as oil or wood (example: SODIAPLAST Senegal), however this makes the regulation of the necessary temperature more difficult and is certainly not a clean source of power.

**Table 1 Comparison of electricity tariffs in Mali, Kenya & Senegal.**

<i>Country</i>	<b>Cost of electricity (In local currency/ kWh)</b>	<b>Cost of electricity (In Euro / kWh)</b>	<b>Cost of running the extruder for one hour (42.8 kW) (Euro)</b>
<i>Mali</i>	130 CFA	0,20	8.56
<i>Kenya</i>	25 Kes	0,19	8.132
<i>Senegal</i>	101 CFA	0.15	6.42

Next to electricity, water is of importance in a plastic recycling enterprise. Water is needed for washing plastic waste material and or for cooling the end products. In case of washing plastic waste, it is possible that polluted water needs to discharge and preferably be treated before that. In case of heavily contaminated water, a wastewater treatment system is a necessary addition to the machinery needed for the enterprise. Cooling the products in a country such as Mali can be a challenge when temperatures may rise to 40 degrees Celsius. Oumar made an innovative water-cooling device because using electricity to cool the water is too expensive.

## 4.3. Markets/marketing

In Africa recycled products are often seen as inferior and of lower quality. People buy them because they are cheap. Kevin states in his interview that people are skeptical of the idea that waste materials is used to produce the end-product as a building material. Awareness about recycled products in Africa is low, this awareness is not the same as in Europe where a recycled product is a unique selling point. People in Africa are not even aware that some recycled plastic products in their houses are made of recycled material. They buy these products because they are cheap. The products made from recycled plastics need to compete with the traditional local market, for example for the roofing tiles this means competing with cement roofing tiles. The unique selling points need to be clear and this needs to be communicated clearly. For instance, that the roofing tiles are lower in weight and are unbreakable.



Higher oil price causes an increase in price of recyclables, furthermore, demand for recycled materials from Europe is increasing. Both issues influence market prices. Markets can be locally, regionally, or globally. The three studies enterprises all manufacture products for the local market, within their city or sometimes regional (Kisumu in the case of ECOTILE and blocks).



Figure 14 Innovative water-cooling device of Oumar.

#### 4.4. The business case/model

The studied enterprises are initiatives from entrepreneurs making money by recycling plastic waste. Their first driver is to establish a profitable business. The selling price should cover and preferably exceed the cost to collect and recycle the plastic waste material. Table 1 shows where these enterprises are placed if we look at the types of plastic that are recycled. They all use HDPE; a type 1 plastic have a high intrinsic value. Often there are quite some competitors on this market competing for the same raw materials.

Table 2 Understanding the value of different types of plastic waste in recycling (adapted from Anne Scheinberg).

Type	Examples	Common situation in studied countries	Business model for making money
<b>Type 1: high intrinsic value, globally or regionally traded commodities</b>	Hard plastics: HDPE, PP preferably sorted in one (bright) colour, PET	Recycled by enterprises or plastic manufacturers (combined with virgin) through private initiatives and rarely end up at dumping sites	Sort, clean and shred plastic waste and sell flakes, pellets, or final product (tubes) PET can be sold in bales if global market allows
<b>Type 2: moderate intrinsic value, locally traded commodities</b>	Faded already recycled hard plastic, transparent film plastics (LDPE), PET	Recycled by private enterprises only when there are local markets available	Roofing tiles? Need to develop markets, customers need to pay higher “conscious” price
<b>Type 3: Negative value materials that damage the environment if discharged or burnt</b>	MLPs, mixed plastics, thin coloured bags and film material, diapers, menstrual health waste products, etc.	End up at dumping sites or in the environment or are burnt	These materials can only be recoverable when there is national subsidy and/or transfer payments from a system of extended producer responsibility (EPR)

The required raw material of the enterprise needs to be available and if not, certain processes must be implemented to prepare the raw material. The processes can for example consist of sorting, washing and/or shredding. Mamadou in Senegal educated women to sort mixed plastic waste. Two of the studied enterprises installed shredders to prepare the raw material. The case studies show that margins are very interesting for tube production out of recycled plastic, the roofing tiles business case is less profitable as new markets need to be developed.

#### 4.5. The enabling environment

Support of local municipalities is minimal although awareness is rising, and national campaigns are launched to sensitize the common public about plastic waste and the importance of separation at source. No subsidy or no support of local governments to promote recycled products, these entrepreneurs rely on foreign organizations for financial support. Due to the increased attention for the global plastic waste pollution, support from international NGOs is increasing.



Figure 15. Example of an awareness campaign in Senegal

#### 4.6. Impact

The studied case studies have considerable impact on jobs (livelihoods) and environment (pollution and climate change). All three entrepreneurs are aware of this impact and the importance of it. They established their business not only to earn money but also with other goals in mind such as cleaning the city from plastic waste and to create job opportunities for young people and waste workers.

#### 4.7. Innovation

All three enterprises can show innovations that these entrepreneurs have implemented, examples are the own water-cooling device at DGB or using a cement mill to mix the raw materials at ECOTYLE. All three entrepreneurs try to solve difficult process conditions with innovative solutions or try to minimize costs by implementing innovations.

#### 4.8. Access to finance for growth

Receiving money to grow the enterprise is not easy in the plastic recycling sector, certainly not in Africa. The waste sector, including the plastic recycling sector does not have a good reputation. Starting enterprises in the sector face challenges in acquiring capital because of the early-stage nature of the business and the prejudice opinion. International banks are of the opinion that waste businesses are equal to corruption, pollution, mafia, etc. and that risks are just too high. It is difficult to change these old-fashioned judgements. Next to this stigma another issue hampering plastic recycling entrepreneurs to start a business is that the first investment to start the business needs to be a considerable amount. A quality plastic recycling processing line with a shredder, extruder, and processing equipment costs around €100,000 – 150,000. Next to this building a hangar where the equipment can be placed needs additional investment. Recent developments show that the waste and recycling sector becomes more and more attractive and the investment climate is improving. All three entrepreneurs received financial support from various donors and funding organisations. On average they obtained €100,000 up to €500,000 Euro



in grant money and loans. This financial support enabled them to buy new equipment, increase their capacity and to grow their enterprise.

More impact investment funds are available for Africa that are increasingly seeking a pipeline in the sector or have invested in a plastic waste recycling enterprise, some examples of investments, grants, or blended finance:

- DOB Foundation: <https://www.dobequity.nl/dob-equity-mr-green>
- Global Innovation Fund: <https://www.globalinnovation.fund/investments/mr-green-africa/>
- Cordaid Investment Management: <https://cordaidinvest.com/news-and-stories/strengthening-the-recycling-market-in-mali>
- Wellers Water Unite impact fund: <https://www.wellersimpact.com/water-unite-impact-investment-strat>
- Bestseller foundation: <https://about.bestseller.com/news/bestseller-foundation-seeks-initiatives-to-fund>

## 5. Future prospects of the plastic recycling sector in Africa

Consumption of plastics is increasing globally also in Africa. And although plastics had brought us many advances, we now clearly understand that the way we use plastic is incredibly harmful and polluting. Many research studies and innovations are underway to work on eliminating plastics by using alternatives or creating circular plastics: fully recyclable plastics that will recirculate and be kept longer in the loop. This sounds very promising, but we must live with the reality, especially in Africa, that plastic waste is generated now, that only a small percentage is recycled. A considerable amount of these plastic end up in the environment, at waste dumps and is burnt.

How to improve this situation? WASTE has a long existence and experience working with plastic waste recyclers. We know the drivers of the plastic recycling sector in low- and middle-income countries and we know what it takes to grow this sector in Africa. We know what it needs to increase recycling rates but also to improve the quality of recycled secondary materials with considering social and environmental measures. Therefore we support entrepreneurs such as Oumar, Kevin and Mamadou, they will be the future leaders in plastic recycling in their countries, they are the frontrunners that will inspire many young people in their country to take up the same challenge.

This chapter gives an overview of some specific conclusions that can be drawn from the information and the case studies in this publication and from our own experience with the sector. This chapter addresses some dilemmas concerning the future of plastic recycling enterprises in Africa and gives some recommendations to improve and grow the sector.

### 5.1. Technology transfer and capacity building: Education is the key

There is a clear lack of knowledge about plastic recycling and equipment needed in Africa. Universities or business education centres do not provide training courses about operating plastic recycling equipment. Oumar, Kevin and Mamadou all three educated themselves in Europe. Many entrepreneurs in Africa have an entrepreneurial mind but lack in administration and organisation of their enterprise and therefore struggle to obtain funding, these entrepreneurs are not able to build a track record what is needed to obtain access to finance. To grow the plastic recycling sector in Africa, capacity building on plastic recycling equipment, trouble shooting and maintenance are needed. Next to this we need to establish of plastic recycling business support centres with coaching programmes dedicated to plastic recycling.

### 5.2. Utilities: We need to develop energy-efficient extruders using solar power.

In many countries in Africa there is an unstable electricity supply and high cost of electricity. Extrusion is a key forming process in a plastic recycling enterprise. Extrusion is an exclusively electrical process and most of the energy used is directly related to operation of the extrusion screw. Support development of plastic recycling equipment with low electricity usage is needed and the usage of solar panels needs to be investigated. The initial cost of energy-efficient extruders may be higher, but it will give rapid returns on the small extra investment.

### 5.3. Market: Change in mindset to develop markets.

At this moment markets are good for the globally trade plastic waste materials such as HDPE and PP. However, the plastic recycling sector, also in Africa, is dependent on the global oil price what makes prediction in future markets uncertain. When the oil prices drops, the market for plastic waste decreases. The case study of Kevin shows that the market for recycled products such as roofing tiles still need to be developed. In Africa recycled products often are seen as cheap and of low quality. There need to be a change of mind set among the public that recycled plastic products are of good quality. And besides that, these products support the fight against plastic pollution.

### 5.4. The business case and need for innovations

The analysed case studies show that to establish a profitable business it is needed to produce a product with sufficient market and that can be sold with enough margins. In Africa, for several types of plastics, recycling is still not an economically or technically viable option. No subsidies or EPR schemes are present to recycle low grade plastics (MLPs, film materials, bags, etc.) and therefore these so-called low-grade plastics are present in the streets, at illegal dumps and in the rivers. Legislation and innovation are needed to facilitate the recovery and recycling of these type of plastics in Africa.

There is a strong need for upstream innovation – solutions that minimize the amounts of plastic produced in the first place, by providing viable alternatives that can be developed and adapted to reduce reliance on plastic or contribute to eliminating plastic usage. But also additional funding and subsidies are needed to fill the financial gap and make recycling of these difficult to recycle plastic possible. EPR funding is a good example to make this happen.

### 5.5. The enabling environment



Government authorities can play an important role in the promotion and the viability of the plastic recycling sector, not only by their approaches to local waste management systems but also by the economic policies they adopt. For example, import regulations on virgin pellets may determine the feasibility and the level of plastic recycling in the country. Furthermore by facilitating separation at source schemes together with the establishment of Material Recovery Facilities, they can organize the supply chain necessary for the plastic recycling sector. By adapting EPR schemes they can facilitate the financial viability of the sector.

### 5.6. Access to finance






More and more international impact investment funds are exploring the waste and recycling sector but still have doubts and prejudices about the sector. For the plastic recycling sector, it is needed to improve image and transparency of the sector to gain trust of the financing institutions and to become a reliable partner. Another factor that is hampering growth of the sector and access to finance is that a first investment to obtain a quality plastic recycling line needs an investment around 100.000 – 150.000 euro. Most enterprises active in solid waste management and/or plastic recycling cannot afford such an investment with the necessary track record and collateral.



## Annex 1. Business case: Producing tubes out of plastic waste (Senegal)

<b>Raw materials:</b> High quality plastic waste (HDPE/LDPE), UV stabilisator (3%), black colorant (0.02%)		<b>Market:</b> agricultural sector (drip irrigation)		<b>Products:</b> tubes (weight: 50 g/m) (diameter : 16 mm)
Investment (CAPEX)				
	Grinder (50 kg/hr output) (650.000 CFA)		Extruder (50 kg/hr) (22,750.000 CFA/35.000 Euro)	
Total investment: 23,400.000 CFA (36.000 euros)				
Business case				
Profit-loss				Per month (CFA)
		Sales Production and sales of 176.000 m/month (8000 m per day) 100 CFA/meter		17,600.000
		Expenses <ul style="list-style-type: none"><li>Raw material (plastic waste (750 CFA/kg), UV stabilisator (1950 CFA/kg) and colorant (2600 CFA/kg))</li><li>Salaries (1 qualified operator and 1 assistant)</li><li>Electricity (total 42.8 kW, 8 hours/day, 101 CFA/kWh)</li><li>Other (rent, telephone, transport, maintenance, etc.)</li><li>Depreciation (Lifetime of 5 years)</li></ul>		6,776.000 110,000 760.812 600.000 390.000
		Total dépense		8,636.812
		Result per month		8,963.188
		Investment: 23,400.000 CFA		(Payback period = 1.3 month)

## Annex 2. Business case: Producing paving tiles out of plastic waste and sand (Mali/Kenya)

<b>Raw materials:</b> Low grade plastic waste (laminates / multilayer packaging) and river sand (60% plastic / 40% sand)		<b>Market:</b> construction sector			<b>Products:</b> paving tiles <b>Weight:</b> 1.2 kg / tile
Investment (CAPEX)					
					
					
	Grinder (50 kg output/5.5 kW) (650,000 CFA)		Extruder (50 kg/hour - 20 kW) (3,000,000 CFA)		Mould (32,500-65,000 CFA)
					Press (325,000 CFA)
Total investment: 8.684.469 CFA (17.360 euros) – Including Agglomerator, mixer (see proposal METRO Groups) and transport from India					
Business case					
profit-loss					Per month (CFA)
	Sales				
	Production and sales of 7,333 tiles/month (333 tiles per day) 278 CFA/tile				2,038,666
	Expenses				
	<ul style="list-style-type: none"><li>Raw materials (plastic waste (50 CFA/kg) and sand (10 CFA/kg))</li><li>Salaries (1 qualified operator and 1 assistant)</li><li>Electricity (total 32.8 kW, 8 hors/day, 153 CFA/kWh)</li><li>Other (rent, telephone, transport, maintenance, etc.)</li><li>Depreciation (Lifetime of 5 years)</li></ul>				264,000 + 35,200 90,000 883,238 300,000 66,666
	Total expenses				1,639,104
	Result per month				399,562



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