

Mini-guide

What can I recycle plastic waste into?

Products ideas and easy market study guide



Key learning outcomes :

- *Get a clear idea of the options for plastic recycling*
- *How to conduct simple, effective simple and effective*
- *Making an informed decision when choosing product(s)*



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The contents of this guide are proposed in **open source**

Contributions to this mini-guide are welcome → please send an e-mail to jean-baptiste@plasticodyssey.org

1. Introduction and selection criteria

The plastic recycling process is an invitation to creativity, as it involves giving new life to waste in one form or another, depending on what makes the most sense. For the same type of deposit and the same region, there can be multiple possibilities and ideas.

This mini-guide aims to broaden your vision, give you ideas and help you make the best decision.

There are many criteria to choose from, and juggling them can be complex:

- the **technical** criterion: what processing tools or processes will I be able to use with the plastics available (HDPE and PET are not recycled in the same way, for example),
- the **economic** criterion: what can be sold in the context and market around me that makes economic sense?
- the **environmental** criterion (which product has the best impact on the environment, taking into account the entire value chain?)
- the **social** criterion (what enables me to have the best social impact? e.g. making demountable shelters for refugees or for disaster zones), etc.
- other criteria: legislation/legal (certification required to sell standardized pipes, for example, or possible restrictions on the use or sale of plastic pyrolysis fuel).

Technical criterion:

The level of complexity of recycling processes for a given product is an important factor to consider, depending on the project's resources and capabilities. For example, making paving stones by mixing plastic and sand in a kettle is within everyone's reach, compared with a plastic pyrolysis process to transform waste into fuel, which involves a much higher temperature, is more dangerous and requires more advanced chemical skills.

Economic criterion:

This criterion is the most obvious and one of the most essential, as it is not specific to the recycling sector but to all companies. It involves being pragmatic and rational about the state of the market, identifying what is already selling and at what price for what quality, and also identifying what is not selling and understanding why and whether there is a need. This is the market research stage.

For example, a good number of projects in Africa instinctively launch into the manufacture of paving stones, because it's something that's easy to do, has been made and shared via videos, and has gone viral. On the other hand, simplicity of manufacture is no guarantee of success.

There are several reasons for this:

- projects that share paver manufacturing methods do not demonstrate the viability of their project,
- if this method is viable in a given geography, it doesn't prove that it's the case in yours,

- for some projects, it seems to have become a default choice, sometimes for lack of ideas. On the other hand, even light market research will certainly give you a better idea, or may even reveal that other products have better potential.

It's often a good idea to start with a flagship product with the best potential, and with a few potential buyers already identified. Of course, it's not out of the question to expand the product range at a later date (but this will most likely entail adjustments to the production chain and therefore investments, so these are important decisions to consider).

Environmental criterion:

It's important to consider the hierarchy of plastic recovery. We often talk about "recycling", which is a bit of a catch-all term, but in reality there are several different ways of recovering waste.

- Some people use the term "upcycling" to describe the transformation of waste into products of better quality than they were before (e.g. making a bench from old cans).
- Downcycling" also refers to the transformation of plastic packaging into lower-quality products (e.g., making fuel to burn in an engine).
- Finally, more traditional recycling refers to the transformation of waste into a product of similar quality to what it was before (e.g. remanufacturing a PET water bottle from used PET bottles).

The level of circularity of these different recycling methods is often judged by your potential partners or backers, and the choice of product made often needs to be justified, especially if you choose a "downcycling" solution.

It's important to note that mixed recycling, such as making plastic-sand paving blocks, is often seen as "downcycling", as there's a loss of quality in mixing as opposed to regranulating separate materials (HDPE, LDPE, PP etc.). Choosing a solution that preserves the quality of plastic resins must be possible and viable (find a market, be profitable, etc.).

Another important point, beyond the economic criterion, is the real impact on the environment. Some projects focus solely on high-value plastics (e.g. PET bottles in the case of plastics), while neglecting low-value plastics such as soft plastics or mixed plastics. In this case, pollution may be reduced, but it remains, and the overall value of the deposit is reduced. Being able to process a more significant proportion of plastics, even if not 100%, brings enormous added value from an environmental point of view. This often requires a suitable technological solution for these plastics, or finding complementary financing solutions to compensate for the shortfall (plastic credit, smoothing out gains with plastics and other higher-value waste, donations, etc.) by selling the positive externalities.

Social criteria :

Depending on the vocation and ambition of your project, it may be important to accentuate its social impact by including this dimension in the value chain, either upstream by valorizing informal collectors, or by formalizing jobs for disadvantaged populations in plastics processing, or by transforming these plastics into socially useful products (e.g. school tables). In all cases, this is an additional differentiating and competitive factor for the project.

2. Product ideas and feedback

Several product categories:

- 1) **pre-treated plastic waste** for use as recycled raw materials by plastics manufacturers:

plastic bails:



washed pellets:



granulates:



Example: [Mr Green Africa](#) in Nairobi, Kenya (progressive investment in more and more advanced materials to produce food-grade pellets)

- 2) 100% plastic or mixed semi-finished products:

planks and profiles - 100% plastic (PE/PP):



roofing tiles and other tiles - 100% plastic or plastic - sand :



Example:

- [Eco Maderas Plasticas](#) in Colombia, which makes "plastic wood" boards and by-products
- [Eco Blocks & Tiles](#) in Kenya (roof tiles, etc.)
- pavers (road, sidewalk, residential) - plastic mix - sand :



Example:

- [BGS Recyplast](#) in Guinea
- [Gjenge Makers](#) in Kenya
- [Nelplast](#) in Ghana

- building bricks for construction - schools, houses etc (100% plastic or plastic-sand mix):



Example: [Conceptos Plasticos](#) (Colombia, school construction project with UNICEF in Côte d'Ivoire)

- Boards:



Example: [ReForm](#) in Viet Nam

- 3) Finished products / supplies from boards, profiles or sheets as wood substitutes:

- tables, benches, chairs :



Examples:

- [Envirotech](#) in the Philippines (picture on the right)
- Gardening pot :
- pallets :



Example: [Repal](#) (Indonesia) for pallets

- bins, composting bins :



Example: [Miawodo](#) (micro-factory Plastic Odyssey) - composting bin

- pontoons, terraces:



Example: [Madera Plastic](#) (Brazil)

- Reinforcements for buildings, solar panels, etc:



Example: [Cedar Environmental](#) (Ziad Abi Chaker, Lebanon)

- Safety barrier:



- Interior supplies: lockers, flower pots, shelves (example of [ReForm](#) in Viet Nam)



- Other outdoor supplies: vertical truss with plates



Example: [Cedar Environmental](#) (Ziad Abi Chaker, Lebanon)

4) **Pipes** (in PE/PP to replace virgin PE or PVC) :



5) **String or foam** (from PET) :

- Yarn from PET for textiles, etc.



- Insulating foam from PET (house insulation, shelters, roofing, etc.):



6) **Roads** (creation of a new type of asphalt by incorporating plastics):



Example: [K K Waste Management](#) in India

- Cement or asphalt additive with a mix of plastics and minerals for making breezeblocks, bricks, roads, etc. (e.g. Resin8 from [CRDC Global](#))



7) **Fuel** - petroleum, diesel (+ kerosene, naphtha) and by-products gas and carbon black (pyrolysis production):



Example: [Scarabtech](#) (micro-pyrolysis - South Africa), [Geo Trash Management](#) (semi-industrial - Indonesia), [Earthwake](#) (France)

8) Products for **small-scale production, handicrafts or very meticulous** / high added-value products:

There are countless examples, especially in the [Precious Plastic](#) community but here are a few ideas:

skateboard :



phone cases



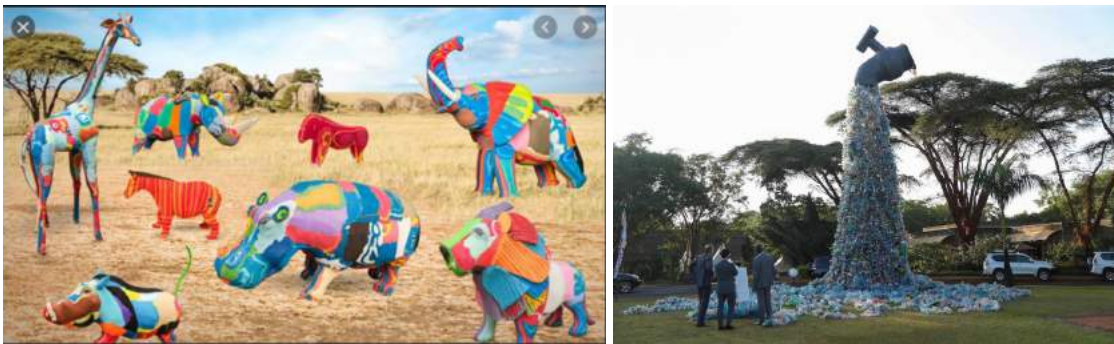
bags :



Example:

- [Jason Knight](#) (incubated in France with Plastic Odyssey Onboard Lab - recycled plastic skateboard)
- [GAFREH](#) (recycled plastic bag - Burkina Faso)

9) Art work



Example : [Ocean Sole](#) (art from flip-flops - Kenya)

10) Others (creativity knows no bounds!):

- Example: boat ([Flip Flopi](#) project in Kenya)



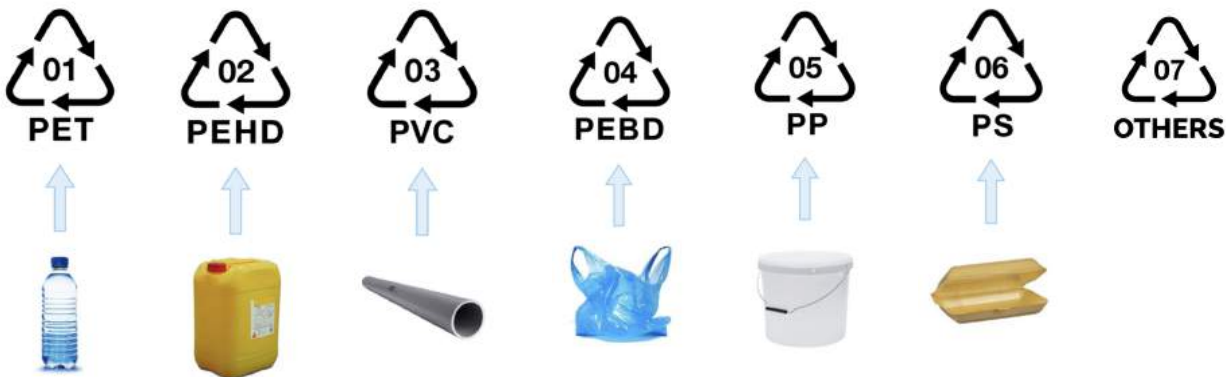
3. From waste to product: how to choose?

After giving a general list, as complete as possible. It is necessary to make the link to criterion #1, which is technical feasibility, by linking the types of waste and the types of products that can be made from them.

Here's a table (choice matrix) that roughly matches the types of waste we find and the products possible on a semi-industrial or local scale:

Types of Products Types of plastics	Pre-treated waste			Semi-finished and finished products - construction materials, furniture	Small products like Precious Plastic	Pipes	Road, Cement additives	Yarn/ Foam	Fuel (petrol, diesel etc)	Art
	Bail	Pellet	Granulates	Planks, pavers, boards & derived products						
PET (1) - bottles - other PET	x	x	x				x	x		x
PE HDPE (2) LDPE (4)	x	x	x	x	x	x	x		x	x
PP (5) rigid soft	x	x	x	x	x	x	x		x	x
Mix PE/PP Contaminated mix				x	x	x			x	x
PS (6) EPS	x	x					x		≈	x
PVC (3)		x					x			x
Others (7)							≈			x
Mix, Multilayers							≈		≈	x
Fishing nets	x	x		x	x		x		x	x

As a reminder, the 7 main plastic categories are listed below.
below (more details in the [guide 1](#) of the Recycling Academy):



4. Make a market study

Having provided information on the technical criterion, it's time to look at another decisive criterion: the economic criterion: is there a local market for the chosen products? This is the well-known exercise of **market study**.

Generally speaking, it's important to be able to quickly and clearly define your flagship product and then your market and targets, because it won't be the same approach to address companies, individuals, towns and so on.

If you want to make a product that has a direct alternative or that already exists on the market (for example, boards that already exist in wood or even recycled plastic from a direct competitor), then you can simply start by studying the trends in these products, the prices charged by "competitors", volumes and therefore sales figures. This will give you a good indication of the price you should aim for. You then need to make sure that you can produce at a competitive price while maintaining a sufficient margin.

If you have an idea for a product that doesn't yet exist in your target market, or that differs significantly from existing products, then you need to sound out the market and potential customers to gauge their interest and test the price you could charge. The best way to validate your product from a usage point of view is to go out and test it on the public to see if it really meets a need. Interviews, forms and prototypes..

The market size

In both cases, another important parameter is the question of market size. Some markets can quickly become saturated, while others are virtually bottomless. For example, very sophisticated finished products such as skateboards have a limited local audience, so you either have to work on small volumes and charge high prices, or diversify your products, or sell via the Internet and deliver to other regions. It's important to have an estimate of the quantity of products you can sell per year. It also needs to be adapted to the quantity of available deposits.

A standard methodology requested by investors is to quantify the market in 3 concentric circles: SOM, SAM, TAM, meaning respectively "Serviceable Obtainable Market", "Serviceable Available Market" and "Total Available market".

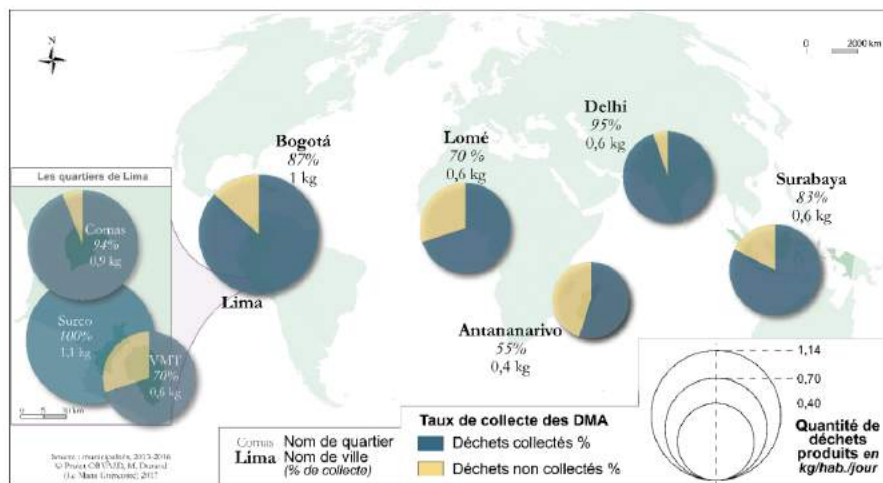
The diagram below shows an example of a cobblestone market:



In addition to the size of the product market, it is important to identify the quantity of available and attainable deposits to coincide with the eventual product market.

These data can be found in characterization reports, if they exist and are sufficiently up-to-date. Otherwise, an extrapolation based on demographics can provide interesting orders of magnitude.

For example, in West Africa and South-East Asia, per capita plastic consumption averages around **0.06 kg/day/inhabitant**, or around 22 kg/year/inhabitant, i.e. 10,000 inhabitants consume the equivalent of 220 tonnes of plastic per year. Plastics also account for an average of **10%** of municipal waste in low- and middle-income countries in the South.



Source: ORVA2D - Le Mans University - M. Durand - 2017

Based on a city's population, we can therefore give an order of magnitude for household consumption of plastics (excluding industrial and other waste).

We then need to consider the % of this waste that can be collected and processed, in order to estimate what we can reasonably expect to have as the maximum input to our recovery process. This can range from 10% to 50% or more, depending on collection performance.

Evaluate the needs and the competition

Once you know more about your target market, it's important to be able to refine your needs analysis and profile by surveying them, or by signing pre-orders or letters of interest as soon as possible in the case of companies, in order to build a more solid case. Mapping out competitors and alternatives is key to positioning yourself (volume, price, quality, customers). If you can't identify any direct competitors, ask yourself why: is it an innovative idea, or simply a crowded market where others have failed?

Definition of Mix-marketing

Keep in mind when doing market research:

→ the aim is to be able to define an effective "marketing mix" that includes:

- the product: what product(s) or service(s) will you offer your future customers?
- price: at what price(s) will you sell them?
- distribution: how will you sell your product(s)? What distribution channels will you use (direct, through intermediaries, online)?
- and communication: how will you get the word out?

→ market research should also help you refine your project:

- identify potential barriers to market entry: for example, some products require testing and verification of standards, such as building materials, pipes or even more so for fuel. These standards or legislation constraints often depend on the local context.
- verify that economic conditions are met
- confirm or invalidate certain initial hypotheses to refine the project.

Once consolidated, your market study will lend credibility to your project and your hypotheses, thanks to tangible proof that you have a market.

To sum up, a BPI infographics explains well the market study process.

Case study

For example, we coordinated a study in Cameroon with a local partner organization. Celle-ci est assez complète et inclut une analyse sur les débouchés mais aussi le gisement sur 3 villes. This will give you a good idea of what you should look for during the study ((even if it's possible to make it simpler initially).

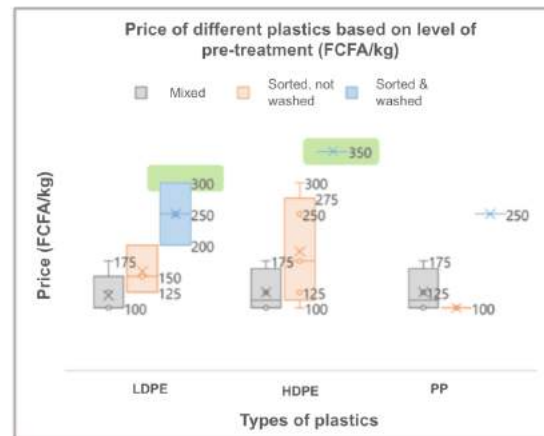
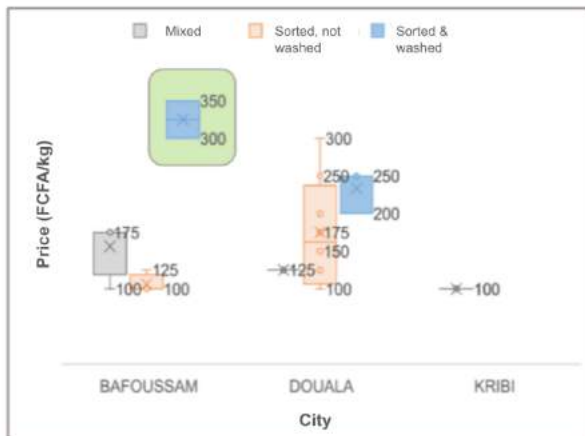
Feedstock study

The study of the price of plastics should be carried out by canvassing different suppliers: networks of informal collectors, wholesalers, SMEs involved in waste pre-treatment, etc. If there are no existing suppliers, then we'll have to set about developing an in-house collection network. If there are no existing suppliers, it will be necessary to develop an in-house collection network, and the study will involve analyzing the cost of collection per kg or ton.

The following is a study carried out in Cameroon on the price of LDPE, HDPE and PP plastics in FCFA per kg at the time of purchase, according to supplier and city:

Location	Stakeholders	LDPE (FCFA/kg)			HDPE (FCFA/kg)			PP (FCFA/kg)		
		Mix	Sorted, not washed	Sorted & washed	Mix	Sorted, not washed	Sorted & washed	Mix	Sorted, not washed	Sorted & washed
BAFOUSSAM	Landfill - waste picker	100			100			100		
BAFOUSSAM	Waste aggregator			300	125	350		100		
BAFOUSSAM	Ville de Bafoussam	175			175			175		
DOUALA	Seller 1		125		175			100		
DOUALA	Seller 3	125			125			125		
DOUALA	Seller 2			250	300			100	250	
DOUALA	REDPLAST		150	200						
DOUALA	AMABO		200		250					
KRIBI	Association STOP POLLUTION	100			100			100		
KRIBI	Door to door collector	100			100			100		

The graphs below illustrate the price differences according to the quality of the deposit and the city, making comparisons easier:



If these prices do not include transport, it is important to also consider the cost of logistics to obtain a more reliable final value:

TRANSPORTATION	KRIBI	BAFOUSSAM	
	Mixed	Sorted, not washed	Sorted & washed
Truck (20 tonnes)	200 000	250 000	250 000
Average price of waste for 1 tonne (FCFA/t)	100 000	125 000	325 000
Value of 20 tonnes of waste	2 000 000	2 500 000	6 500 000
Value waste - transportation cost	1 800 000	2 250 000	6 250 000
Share of transportation on waste selling price	10%	11%	4%

The study presented here is fairly comprehensive, but this can be achieved quite easily on a city scale with 2-5 suppliers and a simple comparison of prices and waste quality, as well as a study of transport from the supplier to the chosen processing site.

NB: If the chosen process uses secondary (non-plastic) products such as sand, for example, it is important to quickly ascertain its availability and price. For example, in island contexts or areas where sand is not an abundant resource, it may not make sense to choose this type of process.

Products study

Having studied the incoming flow (raw materials), we now turn to the market for the products (outgoing flow).

We'll use the Cameroon case study below as an example.

Planks' market (alternatives to wood)

Cameroon is one of Central Africa's leading timber producers, along with the Gabon and Congo sub-regions. These three countries will account for 90% of the region's production in 2021. Cameroon produced 2.4 million cubic meters of wood in 2021.

Sales prices for various wood components are shown in the table below.

LOCATION	SELLER	PLANKS (FCFA/unit)					Square chevron (4 m ² / 1" h) (FCFA/unit)	Structural lath (5m) (FCFA/unit)
		Formwork (500 x 300 cm)	Iroko hard wood (4m)	Pashi hard wood (4m)	Movingul hard wood (4m)	Padou hard wood (4m)		
DOUALA	Seller 1 (next to the round about red light)	4 500	10 000	15 000	15 000	15 000	4 000	2 200
		-	-	-	-	-	4 500	2 500
	Seller 2 (in Deido near Camtel)	5 000	8 000	-	-	-	4 500	2 000
		-	-	-	-	-	5 500	-
	Seller 3 (in Bonaberie)	4 500	12 500	-	-	14 000	6 000	2 200
Seller 4 (in North Akwa)	5 000	13 000	-	-	-	6 500	2 200	
KRIBI	Seller 1 (on main road)	4 000	5 000	-	-	-	5 000	1 000
		4 500	8 000	-	-	-	7 000	1 200
BAFOUSSAM	Seller 1 (city entrance, near bus station)	4 800	14 000	15 000	-	-	5 200	1 600
		5 000	-	-	-	-	-	1 800
	Seller 2 (near Casablanca market)	-	10 000	14 000	-	-	5 500	1 600
	Seller 3 (on main road)	5 000	14 000	14 000	-	-	7 500	1 700
Average Price		4 730	11 056	14 500	15 000	14 500	5 564	1 818

In view of these factors, the marketing of recycled plastic substitutes does not appear to be a viable strategy, given the very strong presence of raw wood, its low prices and the strong lobby associated with it. However, the plastic alternative to wood is an interesting way of combating deforestation, and is particularly popular in Brazil and Latin America.

Paving blocks' market

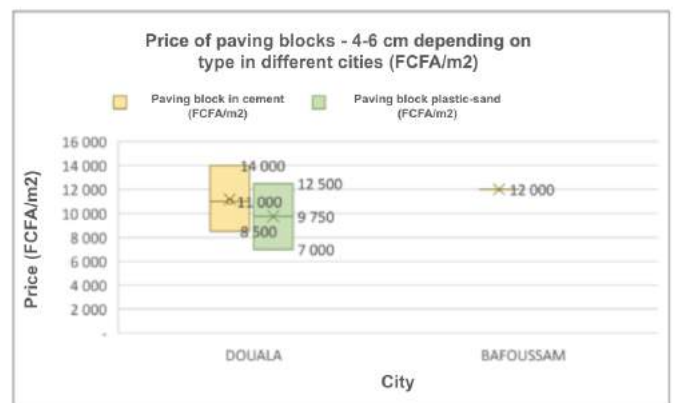
Plastic-sand paving stones need no introduction. It's a process that has taken Africa by storm, although it's still very much in the hands of the local population. Here are just a few of the products available on the Cameroonian market:



Paving blocks from a brochure on the left and from Redplast on the right (source: SCE)

Now let's take a look at the prices charged by different vendors and compare them to the price of concrete paving stones:

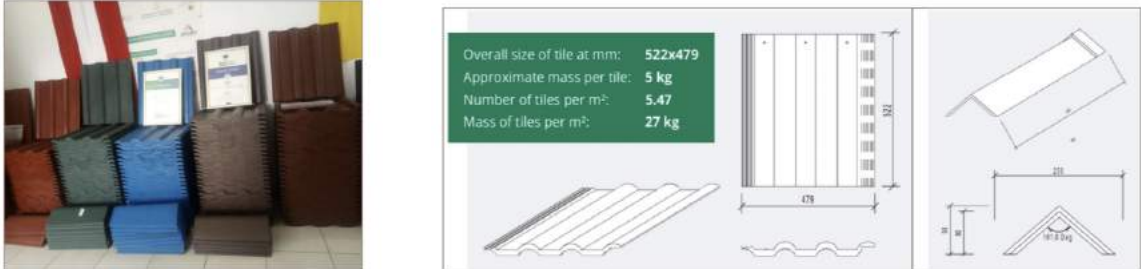
CITIES	SELLERS	Paving block (cement) (FCFA/m ²)		Paving block (plastic-sand) (FCFA/m ²)	
		4-6 cm	10-13 cm	4-6 cm	8-13 cm
DOUALA	Seller 1 (Bonamoussadi)	6 500	11 000	-	-
	Seller 2 (Bonaberie)	5 000	8 500	-	-
	Seller 3 (Ste Eric - Bonaberie)	7 500	14 000	-	-
	Seller 4 (REDPLAST)	-	-	6 500	12 500
	Seller 5 (road side)	3 500	-	-	-
	Pre-collection association	3 500	-	3 500	7 000
KRIBI	Seller 1 (road side)	3 500	on request	-	-
	Seller 2 (road side)	4 500	on request	-	-
BAFOUSSAM	Seller 1 (around market)	5 000	on request	-	-
	Seller 2 (around Kamkop)	5 000	12 000	-	-
		5 500	-	-	-
	Seller 3 (around city exit)	6 500	-	-	-
		5 000	on request	-	-



Plastic-sand pavers are competitive for similar geometries. Its quality can even surpass that of concrete pavers, and this will be even more the case if it is produced on a more industrial scale.

Roofing tiles' market:

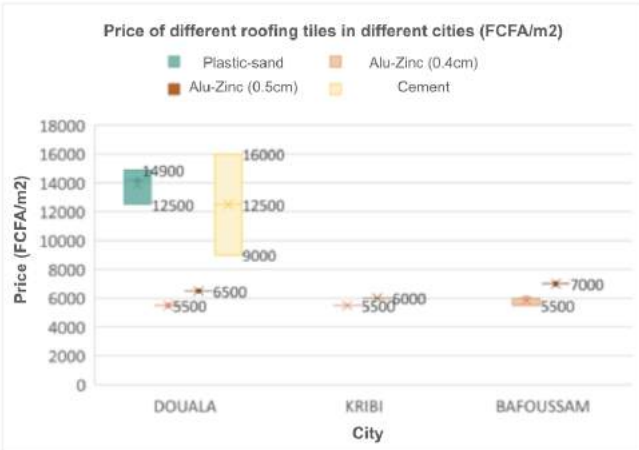
Another interesting but less common product is roofing tiles:



Pictures of Amabo Roofing tiles

It's a widespread product, but the plastic version is still rather expensive. However, it is intrinsically a more cost-effective product, with a higher price per m2 and a lower thickness than raw material-intensive road pavers. All the more reason to compare with alternatives on the local market.

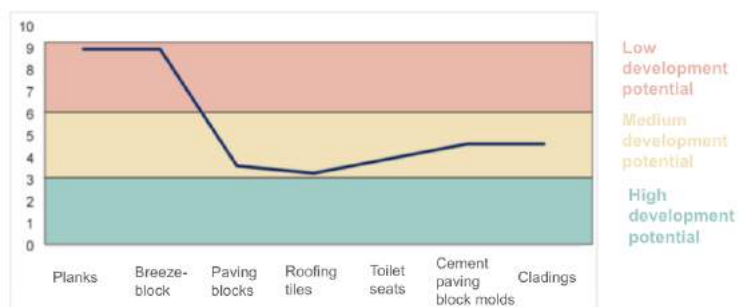
LOCATION	SELLER	Roofing tiles plastic sans (FCFA/m2)		Roofing tiles Alu-Zinc (FCFA/m2)		Roofing tiles Alu (FCFA/m2)		Roofing tiles cement (FCFA/m2)	
		No color	with color	4 m * 0,4 cm	5 m * 0,5 cm	thickness 4 cm	thickness >4 cm	No color	with color
DOUALA	Seller 1 (AMABO) FB	14 200	14 900	5 500	6 500	6 000	7 000		
	Seller 2 (QUIFERROU)		12 500	5 500	6 500	6 000	7 500		
	Seller 3 (AUBAC)			5 500	6 500	6 000	7 000		
	Seller 6 (BRIC à Banaberie)							9 000	16 000
KRIBI	Seller 1 (QUIFERROU)			5 500	6 000	5 900	6 500		
	Seller 2 (SOREPCO)					6 500	7 500		
BAFOUSSAM	Seller 1			6 000	7 000	7 500	8 000		
	Seller 2 (OURAGAN)			5 500	7 000	7 500	8 500		
	Seller 3 (COGENIE SARL)			6 000	7 000	7 600	8 500		



Market study conclusion

This study therefore provides a better understanding of the market for the different pre-selected products, with pavers and tiles in the top group, but with differences even according to city, as competition is stronger in Douala than in secondary towns in particular. In the graphs below, the scoring is from 0 to 10, the lower the score, the better.

MARKET & PRODUCTS	DOUALA	KRIBI	BAFOUSSAM
Planks	9	9	9
Paving blocks	5	3	3
Roofing tiles	5	2	3
Toilet seats	3	3	3
Cement paving block molds	5	4	5
Cladings	5	5	4
Breeze-block	9	9	9
TOTAL PER CITY	5,86	5,00	5,14



Conclusion

At the end of this mini-guide, we hope that you now have a clearer idea of the potential of plastic recycling in terms of outlets, depending on the plastics you process. It's important to remember the selection criteria so that you can make informed decisions, maximizing your chances of success in your projects. Indeed, a large proportion of failures are due to poor product selection.

Let's take the typical example of the project owner who wants to start recycling plastic into finished products and has only seen projects making paving stones. He simply copies this model for his area because it's what he knows and what seems easiest. But it's not necessarily the most relevant or profitable, or worse, there may be no market or too much competition, making the project more difficult or even doomed to failure. Market research is a quick and frugal way (to begin with) of removing as many doubts as possible.

In this mini-guide, we have focused on technical and economic criteria. However, we would like to stress the importance of the other criteria mentioned (social and environmental), which should be borne in mind when making your decision.



It's now up to you to take this knowledge and apply it to the environment around you.