

Article

Shifting Towards Sustainable Tourism: Organizational and Financial Scenarios for Solid Waste Management in Tourism Destinations in Tunisia

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Received: 28 May 2019; Accepted: 21 June 2019; Published: 29 June 2019



Abstract: Tourism in Tunisia generates large amounts of solid waste, especially during the summer, and doubles the amount in most big tourism cities like Hammamet, which makes its management more complicated. Municipalities lack the financial means to ensure sustainable solid waste management (SWM) in tourist areas and need an intervention from all actors to reduce financial and technical pressures and implement sustainable solutions. This paper presents a descriptive research method that focuses on an analysis of the current SWM concept in tourism areas in Tunisia and proposes new sustainable organizational and financial models. These are based on the collaboration of different stakeholders at both national and local levels; and supported by extending the responsibility of the producer through the creation of a new system operator to take charge of the organization and financing of packaging disposal and recycling activities. In addition, the extension of the recovered material for recycling through extended producer responsibility (EPR) could support the system. The performance of current SWM shows that it has failed to ensure the cleanliness of tourism destinations is sustainable. Tunisia generates 2.8 million tons of municipal solid waste (MSW), between 20% to 30% of which are recyclable materials. The current system for packaging in Tunisia (ECO-Lef) only collected 3400 tons in 2018 compared to 15,800 tons in 2010, and the total recycling rate in the country does not exceed 5%, which makes the waste management system inefficient and unsustainable. Proposed solutions should be supported by legal and technical interventions, such as waste prevention, minimization, sorting at source, and the provision of education programs for citizens and tourism establishments.

Keywords: sustainability; tourism; extended producer responsibility; decision-making; recycling; financing; Tunisia

1. Introduction

Sustainable tourism is a focal point in discussions on the development of environmentally integrated tourism. However, existing researches show that sustainability is a complicated concept that requires more critical analysis [1]. Shifting from a linear to a circular economy to preserve the environment, generate sustainable economic growth and spread ecological awareness throughout the population, can be considered the most adapt way for improving solid waste management (SWM) concepts [2].

Indeed, tourism is considered a driver of socioeconomic development in many regions and areas, particularly in developing countries [3]. However, it has been recognized as demanding high energy

and water resources, which also generate significant amounts of solid waste [4]. It is thus recognized as a resource-intensive industry [5].

The development of tourism as one of the largest industries in the world requires effective SWM measures [6]. SWM is considered one of the most significant environmental aspect of tourism activities [7] as cleanliness of these destinations is an essential requirement. In Tunisia for instance, tourism saw a 17.4% increase in arrivals in 2019 compared to the same period in 2018, according to the Tunisian Ministry of Tourism, which will generate more waste. Through exhaustive coverage and the recycling of packaging, the appearance of tourism destinations, roads, and beaches will be significantly improved [8]. This factor could have a positive impact on tourism and thus on overall economic development in the country [9].

Packaging always aims at protecting a specific product. Accordingly, the materials used in packaging and material compositions are polyvalent. The volume of products is increasing globally and exchanging goods is no longer limited to the domestic market in each country [10]. Similar situations arise in supermarkets across the world where packaged goods from large international businesses dominate and the wide variety of colors, shapes, and materials encourage consumers to make purchases. Packaging waste is actually a relevant resource, although it has not always been shown to have a positive market value. Recycling, or at least energetic recovery, has several benefits over other waste management options. It reduces production costs, the demand for landfill related facilities, saves energy and natural resources, and generates job opportunities [11]. For example, in Germany, there were more than 270,000 people working in some 11,000 companies with an annual turnover of around 70 billion euros in 2018. More than 15,500 waste management facilities help to conserve resources through recycling and other recovery operations [12].

Unfortunately, in many countries, including those of the Middle East and North Africa (MENA) region, levels of packaging recovery remain very low (Egypt 10%, Algeria 8%, Bahrein 5%, Iraq 5%, Libya 3%, Tunisia 5%) [13].

However, the mismanagement of waste is considered the main factor contributing to beach, marine, and ocean pollution [14]. Many other factors should also be taken into consideration, such as street litter, manufacturing sites, plastic processing, and transport [15]. The image of a beach changes rapidly as a result of pollution or other marine debris, and travelers do not hesitate to change their plans very rapidly [16]. This parameter plays a particularly important role in the decision to travel. Mathieson and Wall suggest that this decision precipitates a series of subsequent decisions, including those relating to environmental conditions. Local recreation and tourism industries can suffer major economic consequences as a result of a damaged image [16,17]. According to the results published by the World Wildlife Fund (WWF) in June 2019 [18], Tunisia generated 0.25 Mt of plastic waste in 2016, of which 0.05 Mt (20%) remained uncollected and 0.20 Mt (80%) was collected for waste treatment. A total of 0.15 Mt (60%) of this waste was sent to landfills, 0.04 Mt (16%) was openly disposed of in the wild, and only 0.01 Mt (4%) was recycled. In 2016, it was determined that 8.5 kT of plastic waste was discharged each year into the Mediterranean Sea. The Tunisian economy loses about \$20 million (USD) a year due to plastic pollution affecting tourism, shipping, and fishing sectors

SWM is an important process and has major impacts on the development of a sustainable tourism model [19]. It is a complex process that encompasses multiple and interconnected issues. The characteristics of solid waste in tourism destinations and the amounts of waste generated during the year or in special seasons make the process even more complex. For the case of Tunisia, the country produces more than 2.8 million tons of solid waste per year (last National Agency of Waste Management (ANGED) statistics 2017) in comparison to 1.8 million (in 2002), with an increasing rate of 2.8% per year. About 80% of the generated waste is disposed in sanitary landfills, while about 20% ends up in inappropriate areas. At the moment, 10 landfills in Tunisia and 56 transfer stations are actually in exploitation. However, three landfills in different tourism municipalities (Monastir, Kerkennah, and Djerba) and six transfer stations were closed, due to social manifestations and real estate problems. All the landfills and transfer stations are constructed by ANGED and exploited by

private companies. The construction of these infrastructures led to the close of uncontrolled dumpsites, following the National Waste Management Strategy 2010–2016 elaborated by the government. Tunisia has successfully moved from dumpsites to more sanitary landfills with methane collection and leachate treatment. Currently, the Tunisian government's vision is to ensure the transition to solid waste valorization and to stabilize the organic fraction before landfilling to reduce greenhouse gases emissions. To this end, the government decided to build 18 mechanical biological treatment (MBT) plants in different governorates.

In fact, when addressing SWM issues in tourism destinations, it is appropriate to use an integrated and sustainable approach that recognizes the various stakeholders and clarifies the responsibilities each one holds.

In tourism areas, SWM services are provided for tourists and local citizens. These are provided either directly (by the municipality) or by contracting a private service provider. SWM services are mainly related to the collection, transport, and treatment of generated waste. Ensuring a clean tourism area is considered an essential service and supports economic and social activities in tourism cities [20].

The development of an innovative and participative approach [21] that can accommodate the needs of local citizens, tourists, and visitors' needs is therefore required. To realize this aim, cooperation among the government, local stakeholders, the private sector, and public service users is vital if the SWM service is to be both efficient and effective.

Indeed, extended producer responsibility (EPR) is an increasingly popular instrument for solving SWM problems. It is an environmental approach based on the "polluter-pays" principle, where those who introduce packaging or packaged goods into a country's market remain responsible for them until the completion of the packaging life-cycle [22]. The extent of producer responsibility depends on the specific model applied and is usually only financial, although in some cases it is also organizational [23]. In this system, companies that introduce packed products into the market are obligated to collect, sort, and recycle the packaging of these goods or dispose of them in an environmentally friendly way as soon as they have reached the end-of-life-phase [22]. According to [24], and as an example of the European experiences related to EPR, Germany collected about 2.4 million tons of lightweight packaging, about 2 million tons of paper/cardboard, and more than 2 million tons of glass via the EPR system. In Belgium, the producer responsibility organization recycles around 90% of all packaging put on the Belgian market annually and by now has created about 2500 job opportunities. In France, the organization was able to gather 9.5 million euros for packaging waste management activities, from the collection, to the sorting and recycling, and recycled 56 million tons of packaging waste. Finally, in Spain since 1998, the organization has managed to recycle 19.3 million tons of packaging and has generated 42,600 jobs in Spain, over 9400 of them direct. It is also important to take into consideration, that there are a multitude of approaches and systems of this kind in many countries, which are referred to collectively as "EPR systems" [25].

Several key questions that arise in relation to solid waste generated in tourism areas that is increasingly impacting the environment: Who will assume the responsibility for all the packaging that is no longer needed after only a very short service life? Who should ensure that packaging is recycled after use or disposal? Who is responsible for the organization of the SWM system in tourism areas and who should bear the costs?

2. Methods

2.1. Analyses of the Current Organizational Concept of SWM in Tourism

For this work, a participative and descriptive approach was employed. First, to analyze the organizational and financial SWM concept in the tourism sector in Tunisia, data was collected through observations and analyses of documents. Accordingly, interviews and discussions were then held with key administrators and officers of several tourist municipalities, officers of central government agencies, private contractors and recyclers, local citizens, and tourists. Data was also obtained from

official documents, reports, and forms pertaining to this research. The purpose of the first part of this paper is to analyze and describe the SWM process and the role of different actors in ensuring clean tourism destinations in Tunisia.

2.2. Diagnostic Assessment of the Current Material Recovery and Recycling System (ECO-Lef) and Discussion of Optimization Possibilities

To diagnose the current solid waste recovery and recycling system in Tunisia, several visits were made to different institutions and national and local authorities relevant to the sector. After collecting basic information about the situation, basic principles of EPR and international experiences related to the concept were presented and discussed to introduce the concept of EPR, its objectives, and organization, to be considered as a new approach for the Tunisian authorities.

The concerned actors and their respective current roles are presented in Table 1.

Table 1. Main stakeholders and discussions with actors.

Institution	Role
Ministry of Local Affairs and Environment (MLAE)	The MLAE is responsible for elaborating strategic concepts and supporting solid waste management (SWM) activities.
National Agency of Waste Management (ANGED)	ANGED currently has primary responsibility for the organization and operation of the ECO-Lef system.
Tunisian Union of Industry, Commerce and Handicrafts (UTICA)	This structure brings together the professional structures of the different economic sectors. Its mission is to promote the private sector and act as a spokesperson for companies with public authorities. The foundation includes private collection and recycling companies as well as producers and manufacturers.
Ministry of Finance	The Ministry of Finance is responsible for collecting eco-taxes and financing part of the ECO-Lef budget and SWM operations.
Ministry of Tourism	The Ministry of Tourism ensures implementation of government policy in the field of tourism. It is the main sector concerned with ensuring clean beaches and destinations in order to attract more tourists to the country.
Tunisian Federation of Hotels (FTH)	The federation aims to contribute to the promotion of the hotel industry within the framework of the national economy.
Private sector (collectors and recyclers)	Private collectors and recyclers represent key actors in this process. Their presence in tourist destinations can open the doors to more recycling and sorting at source.
Producers and manufacturers (national and international companies)	The entity whose brand name appears on the product itself or the importer. In the case of packaging, the filler of the packaging is considered the producer. They are members of UTICA.
National Institute of Statistics (INS)	INS is a public establishment responsible for the production and analysis of official statistics in Tunisia.
Packtec	The Technical Center for Packaging, Packtec, aims to improve the competitiveness of the sector through the provision of assistance, consulting, and technical services related to packaging, transport, logistics, and impression.

The purpose of these visits was to understand existing organizational and legal frameworks, and collect data related to the ECO-Lef system. In addition, the financial framework (the financing of the system and its costs) was also analyzed. A participatory approach was employed to discuss possible optimization scenarios during these meetings.

2.3. Study Area Characteristics

Tunisia is a small country on the North African coast with a 1300-km-long coastline. It occupies a central position in the Mediterranean and is home to a very important mass tourism industry that represents a major source of environmental pressure on natural resources and coastal areas (water and waste pollution) [26]. More than 8 million tourists visited Tunisia in 2018 [27] and tourism accounts for 8% of gross domestic product (GDP) [28].

However, tourism in Tunisia has undergone major changes in recent years and sustainable solutions must therefore be put in place to ensure clean destinations. In Tunisia, SWM is mainly the responsibility of municipalities [29]. In Tunisia, there are 44 tourism municipalities shared on 18 governorates. Furthermore, the solid waste generated from hotels is mostly mixed according to a

questionnaire conducted by [30] and sorting initiatives are infrequent. This increases collection costs and reduces the lifespan of landfills [30]. For instance, interviews performed by [30], indicate that 83% of the hotels collect mixed waste, which is then sent to landfills. The same source indicates that hotels generate large amounts of mixed solid waste, which can be much higher during the summer period where they represent a greater share of the total waste generated (e.g., 54.2% in Hammamet).

2.4. “Extended Producer Responsibility” (EPR) Principle

According to the Organisation for Economic Co-operation and Development (OECD), EPR is “an environmental policy approach in which a producer’s responsibility for a product is extended to the post-consumer stage of a product’s life cycle” [31]. In practice, EPR recommends that producers assume responsibility for collecting or taking back used goods and for sorting and treating them prior to eventual recycling. See Figure 1.

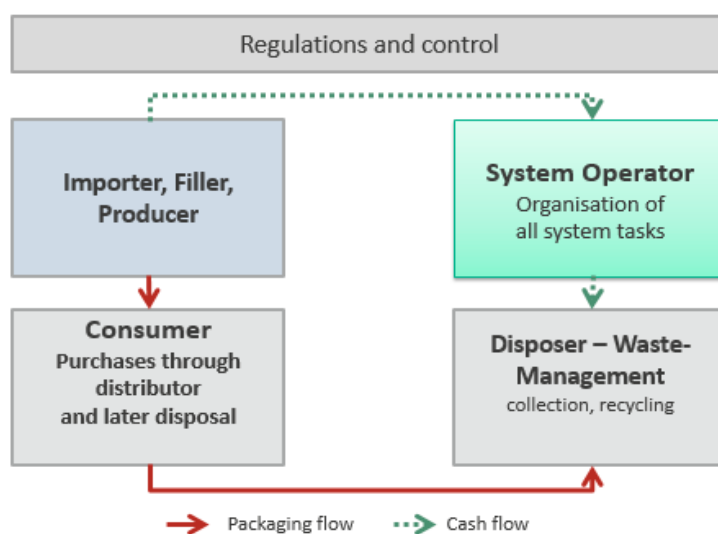


Figure 1. Foundation of an extended producer responsibility (EPR) system for SWM development.

To transform individual responsibility into collective responsibility, a concrete EPR organization (System Operator/Producer Responsibility Organisation) should be established. Those producers and importers responsible for the financing and organization of the EPR system must therefore organize or assume system responsibility through a predetermined form of organization. This institution is then referred to a system operator.

The producers of products subject to EPR should be clearly defined. According to OECD, the “producer” is defined as the entity with the greatest control over the selection of materials and the design of the product. This could be the brand owner/importer or the filler of the packaging rather than the firm that produces the container.

3. Results

3.1. Diagnosis of the Current Organizational Situation of SWM in Tourism Destinations in Tunisia

SWM in tourist destinations has its own role to play. This process is more complex as local authorities have primary responsibility for effectively managing large amounts of waste to satisfy local citizens, visitors, and international tourists. The collection process is a high priority in the management of solid waste in tourism areas [30] and has a direct effect on the cleanliness of the destination. SWM in tourist destinations encompasses waste collection from streets, households and tourism establishments (hotels, restaurants, and so on), the cleaning of the streets and roads, cleaning of beaches, communication with waste generators, and so on.

Municipal solid waste in Tunisia refers to the waste collected by the local government (the municipality) and includes household, commercial and industrial solid waste, street sweeping, and beach cleaning. These efforts are supported by central government which ensures special cleaning actions take place during the year (with the support of Coastal Protection and Development Agency (APAL)), especially during the summer period, to provide a clean destination and beaches for tourists and visitors.

Figure 2 presents the general organizational scheme of SWM in tourism in Tunisia.

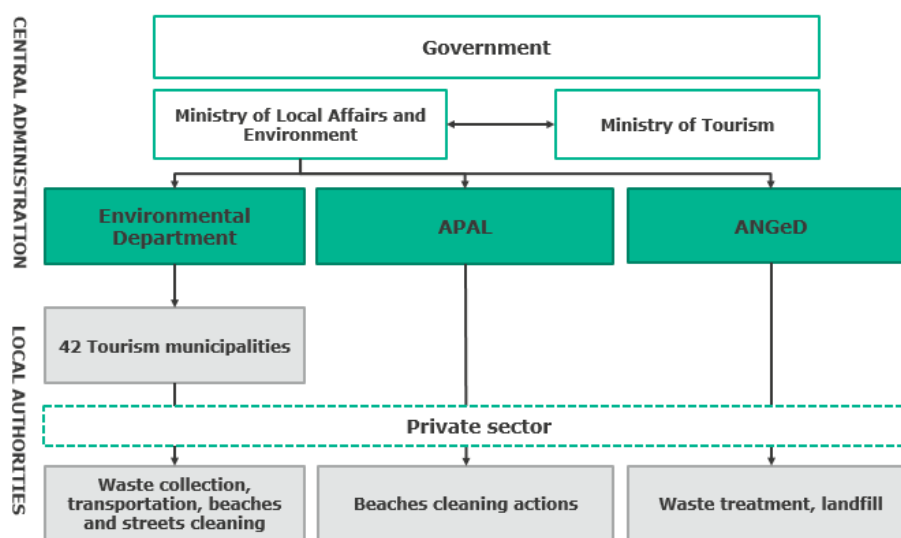


Figure 2. Institutional framework of SWM in tourism in Tunisia.

Overall, hotels pay general taxes on 2% of their turnover; 1% for the municipality budget and 1% to the tourism protection fund. According to [26], this contribution is considered insufficient as it does not cover the SWM costs paid by the municipality.

Chaabane et al. also claim that the number of hotels that participate in sorting their waste at source is inadequate (only 17% of the hotels questioned in Tunisia contribute with small and inefficient sorting and composting programs), despite the existence of a large potentially recyclable fraction in the generated waste [30]. See Figure 3.

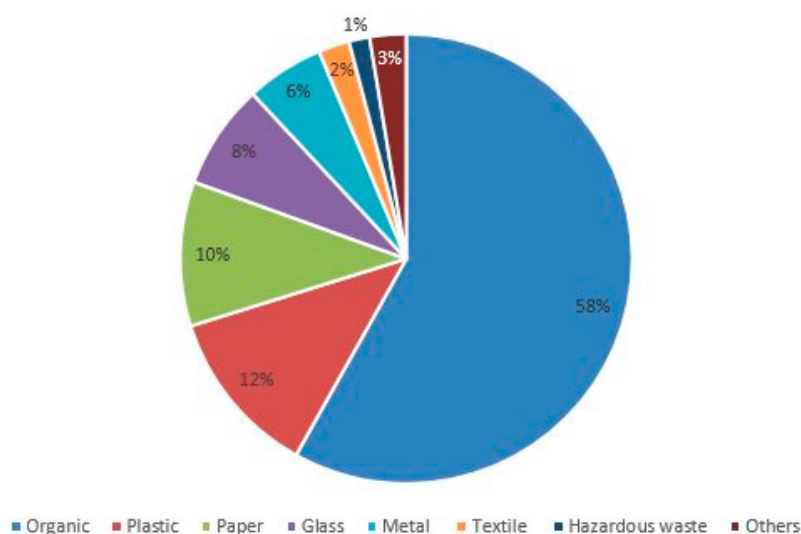


Figure 3. Characteristics of the solid waste generated by hotels in Gammarth and Hammamet in Tunisia (2018) [26].

Moreover, with the exception of some pilot tests, no sorting at source in households exists in the country. This is placing even more financial stress on the municipality which is suffering from several technical, financial, and organizational problems that present obstacles to the appropriate management of solid waste. These problems become more complex during the summer as the return of local citizens living abroad increases the quantities of waste generated.

Nevertheless, an interview conducted with 50 hotel guests in Tunisia and published by [30] shows that all guests wanted to stay in a clean destination and were satisfied with the standards of cleanliness and hygiene in the hotel. However, 90% of the guests were somewhat dissatisfied with the cleanliness of the streets around the hotels, while 50% were unhappy with the cleanliness of the tourist area in general. All guests who completed the questionnaire complained about the lack and/or insufficient provision of waste bins. Furthermore, responsible hotels were asked in a separate questionnaire about their opinion regarding the cleanliness of the tourism area. A total of 88% of the hotels were neither satisfied with the cleanliness of the tourist area nor the locality of the hotel and the beaches.

3.2. Stakeholders' Responsibilities

In Tunisia, several actors participate in SWM in tourist areas. The main stakeholders in this process are the municipality, the private sector, tourism businesses including hotels, the Ministry of Local Affairs and Environment, the Ministry of Tourism, and the Ministry of Finance, all with differing degrees of intervention. Table 2 details their separate responsibilities and characteristics.

Table 2. Current responsibilities of different stakeholders in tourism destinations.

Partner	Role and Responsibilities	Characteristics
Municipalities	Waste collection and transportation; cleaning the streets and beaches; development of solid waste collection infrastructure.	Limited resources and know-how; bureaucracy; starting the decentralization process; lack of data about the sector.
Hotels	Solid waste storage and preparation for collection; responsibility for cleaning the surrounding beaches and supporting the efforts of the municipality (not regularly); paying taxes (2% of turnover) for different services.	Limitation of know-how related to SWM and sorting; in some cases, lack of financial resources (small businesses); motivated to have labels.
Ministry of Local Affairs and the Environment (MLAE)	Planning and coordination of special cleaning actions; development of national strategies.	SWM strategy to be clarified; limitation of resources.
Ministry of Tourism	Support for special cleaning actions; discussing with municipalities and the MLAE the action plan of the Tourist Destinations Protection Fund.	No direct intervention in the SWM field; no experience in the SWM sector.
Private sector (collectors and recyclers)	Participation in collection and cleaning efforts; sorting and recycling activities.	Lack of private sorting and recycling companies; lack of available recyclable quantities.
Coastal Protection and Development Agency (APAL)/National Agency of Waste Management (ANGED)	Organizing special cleaning actions.	In charge of many other activities; lack of logistical means.
Community	Special cleanup actions organized by Non-governmental organizations (NGOs) and local organizations.	May lack resources, expertise, motivation, and organization; often unwilling to pay for services; lack of awareness and information related to the collection time, the local strategy, and so on.

In cases of mixed solid waste generation in tourism destinations (households, hotels, and so on), the municipality is responsible for collection and transportation. In rare cases where the waste generator sorts their waste, two types of solid waste are eliminated: residual waste (collected by the

municipality) and recyclable waste such as paper, cardboard, plastics, metals, and glass (collected by private companies or informal collectors).

These actors are engaged in SWM without any special strategy. In practice, a bottom-up strategy is employed in Tunisia where waste is collected, landfilled and treated sanitarilly, and small reducing, reusing, and recycling actions are initiated.

3.3. Performance of and Barriers to Adequate SWM in the Tourism Sector in Tunisia

Based on the data collected and analyses of the SWM in tourism areas in Tunisia, we can conclude that both national and local authorities are spending a considerable amount of effort and finance to ensure the collection of waste from households, tourism establishments, streets, and beaches. In fact, the municipal cost of collection, transport, and landfilling a ton of waste in tourism areas in Tunisia is comprised between 20 and 32 euros (where only 5% to 10% are paid for deposit and treatment by the municipality, the rest of the treatment costs is paid through the eco-tax). These costs could reach up to 149 euros in some cases, such as Djerba Island (in 2018), where a waste management crisis has existed since 2012, considering the importance of the island in terms of tourism. However, for many reasons, local authorities and actors cannot provide sustainable SWM.

3.3.1. Lack of Assessment in SWM Planning

To perform effective planning of SWM in tourism destinations, many parameters should be considered, such as the stakeholders, the population, and the number of tourists and tourism establishments. However, the population of tourism destinations in Tunisia is not stable as it varies according to the number of visitors and tourists. In fact, there is no concrete data upon which to conduct effective SWM planning. Data should therefore be collected and organized by local authorities, Ministry of Local Affairs and Environment (MLAE), and ANGED in collaboration with the Ministry of Tourism, the Federation of Travel Agencies (FTAV), the Federation of Hotels (FTH), local NGOs, and universities. Such data would be an excellent asset in supporting the decision-making process and SWM planning in these areas.

3.3.2. Responsibilities are Not Clear

SWM responsibilities between different stakeholders must be clarified. Municipalities are actually playing the primary role, as they represent the local governances and, since May 2018, the date of the last local elections where the aim was to decentralize decision-making, they now hold considerable power. However, municipalities suffer from a lack of resources, infrastructure, and the know-how needed to correctly perform their role. In large tourist destinations such as Sousse, Hammamet, and Djerba, municipalities face additional problems ensuring a clean destination due to the massive quantities of solid waste generated. The central government is supporting this process seasonally through APAL and the fund for the protection of tourism destinations. However, the role of the Federation of Hotels (FTH), the Tunisian Federation for Travel Agencies (FTAV), and indeed the hotels in relation to SWM remains neglected.

3.3.3. No Sustainable Financing

Tunisia has also experienced several economic difficulties, especially after the revolution [32]. This has affected the service provided by the municipality as it has lacked the financial means to perform SWM correctly. SWM in tourism destinations is financed mainly by the municipal budget and taxes paid by hotels (directly to the municipality and to the fund for the protection of tourism). However, the rate of recovering taxes from local citizens is insufficient and does not exceed 27%. Furthermore, the responsibility of waste producers, who put the packed goods into the market, remains low, despite their membership of several waste recovery systems created by ANGED.

3.3.4. Weakness in Waste Sorting at Source

Waste sorting at source in households and in tourism establishments (hotels, resorts, restaurants) is considered important in decreasing the amount of solid waste to be landfilled. Local governments in Tunisia do not strictly implement this process, despite the existence of a framework law allowing a municipal order to apply this system. Currently, not sorting at source from households exists.

The first priority of municipalities and national authorities is to ensure good collection of solid waste, in terms of whatever was mixed or sorted, to make the city clean and satisfy local citizens and tourists. Decision-makers are cognizant of the importance of implementing waste sorting at source, which could decrease the amount of solid waste to be collected and treated and reduce SWM costs. Waste sorting could also play an important role in changing the composition of solid waste generated. Furthermore, some hotels are implementing small initiatives to sort recyclable materials for sale to private collection companies. In communities and households, local people do not pay attention to the benefits of selecting waste because, first, they do not have a clear infrastructure available to support this, and, second, they are not aware of its importance, are not motivated to sort at source, and do not receive any financial benefits from sorting.

3.3.5. Industries, Tourists, and Local Peoples' Behavior in SWM

A total of 44 tourism municipalities generate immense amounts of waste during the year, especially during the summer period, due to tourism activities and visitors. In Tunisia, these zones have shown an increase in the total amount of solid waste generated over the last few years due to the growing number of tourists and the high occupancy rate in tourism establishments. Local people are not aware of the need to reduce and sort waste at source. It is common to see them leaving waste on the streets and beaches. Among the reasons for this are a lack of relevant education and communication programs and the absence of an adequate infrastructure (bins on beaches or in the street, sorting bins, and so on). In addition, SWM programs aiming to minimize, sort, and valorize waste in the hotel are rarely established.

3.4. Diagnostic of the Current Waste Recovery and Recycling System (ECO-Lef) in Tunisia

ECO-Lef is a Tunisian public system for the recovery and recycling of packaging waste that is implemented in partnership with local authorities. It comprises the collection of recyclable materials under the terms of conditions and agreements of ANGED, and also the recycling of plastic waste under the terms of reference and agreements for obtaining monthly quotas of these materials from ANGED. The ECO-Lef system was created to reduce the landfilling of packaging waste, limit the negative impact resulting from the exorbitant amount of packaging waste in nature, and promote the recycling and recovery of packaging waste. See Figure 4.

According to the ordinance based on plastic and metal packaging (a capacity greater than or equal to 100 ml), the ECO-Lef system includes bottles of soft drinks and water (Polyethylene Terephthalate (PET)), milk bottles (High-density polyethylene (HDPE)), plastic films and bags (made of Polypropylene (PP)), and metal boxes (aluminum).

Table 3 presents the materials most commonly collected by the ECO-Lef system in 2016, where around 2.8 million tons of MSW were generated. As shown, PET plastic bottles represent 67% of the total quantity, followed by plastic membranes at nearly 29%. However, an important amount of packaging is not collected by the system. This table shows the importance of the PET plastic bottles in the ECO-Lef system, which could be explained by the easiness of the collection of this material and its availability to informal waste pickers, its high value, and the existence of a good market.

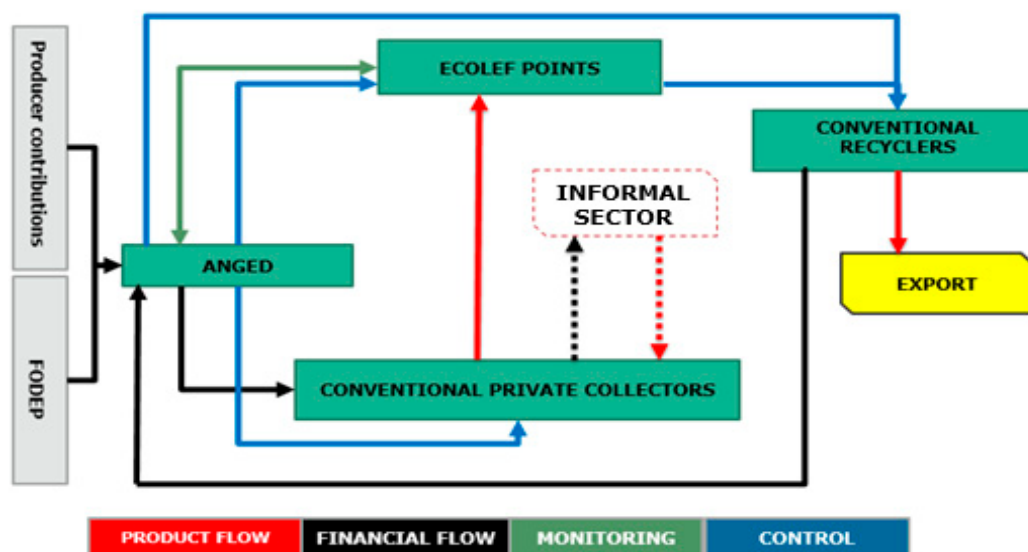


Figure 4. Financial, product, monitoring, and control flows within the ECO-Lef system.

Table 3. Quantities of different materials collected by the ECO-Lef system in 2016 in Tunisia (in tons).

PET Bottles	Flasks of Milk	Plastic Membranes	Bags with Cradles	Metal Cans	Caps for Bottles	PEHD (Cleaning Products)	Films	Total
5575	96	2368	14	0.3	32	126	55	8267

3.5. Costs and Financing of the ECO-Lef System

The ECO-Lef system is principally financed by the Industrial Depollution Fund FODEP fund (eco-taxes) which is represented by the (5%) tax paid on the importation of plastic products (including empty plastic packaging and raw material, no tax has to be paid on the importation of already filled packaging). The Ministry of Finance is the department primarily responsible for financing ECO-Lef, based on the budget proposition and according to the quantities collected by ECO-Lef. Due to a decrease in the quantities collected, the budget allocated to the system is also decreasing. The evolution of the quantities collected by ECO-Lef points is presented in the following figure.

Figure 5 shows that the quantities collected have decreased considerably since 2009, reaching only 5400 tons in 2017 and 3400 tons in 2018.

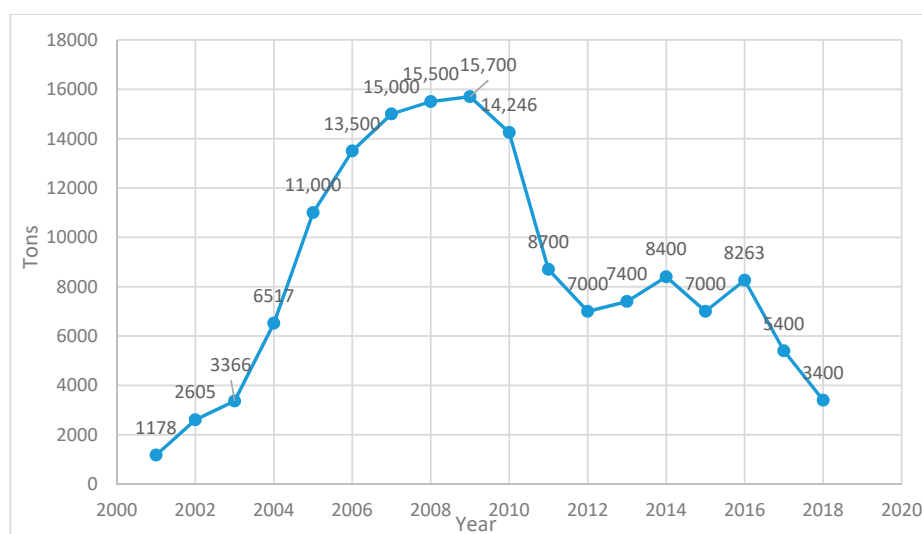


Figure 5. Evolution of the quantities of recyclable materials collected by the ECO-Lef system (tons/year).

The main reasons are indeed the development of the parallel collection of packaging by private collectors (private collection points) working out of the ECO-Lef system and delivering directly to recyclers in a formal way. In addition, the lack of equipment and resources necessitated the closure of several ECO-Lef collection points.

Financially, and according to the law, producers and fillers should pay contributions to the system. However, based on the data collected, only around 5%–10% of the companies are paying their voluntary contributions to ECO-Lef.

3.6. Role of the Informal Sector

Waste collection and recycling is a hot topic in Tunisia because many people are involved in this activity and most work informally. This phenomenon can be observed in all of Tunisia's cities, both poor and rich districts. Informal waste collectors (named Barbéchas at the national Tunisian case) are not visible in the current ECO-Lef system, despite the important role they play in preserving the ecosystem. Their number is estimated to be between 10,000 and 12,000 in the country. Barbéchas depend mainly on the sale of secondary materials extracted from the waste stream to intermediate brokers. These collectors are able to obtain low prices that are a quarter (or less) of the physical value practiced at the top of the value chain. Recyclable waste generated by households, supermarkets, and buildings is collected mainly by Barbéchas. The latter are also active in landfills used to collect the remaining recyclable materials gathered by municipalities.

Two possibilities are available to Barbéchas:

- Selling the collected quantities to private collectors or informal collectors and then to recyclers in order to be exported.
- Selling to a private company (member of the system) and then to ECO-Lef points (created by ANGED in collaboration with the local authorities) where it will be sorted and baled so that it can be redistributed equitably to “conventional recyclers”. Aggregated private companies can then sell to other private companies. Recycling centers form the final chain in the ECO-Lef system. Plastic packaging will either be recycled or processed into pellets for export.

At present, Barbéchas cannot directly access the collection points managed by ECO-Lef as these are open only to holders of commercial licenses and have to be approved by ANGED. In consequence, the majority of Barbéchas cannot benefit from the high prices guaranteed by ECO-Lef and are therefore obliged to use intermediaries offering lower prices. See Figure 6.

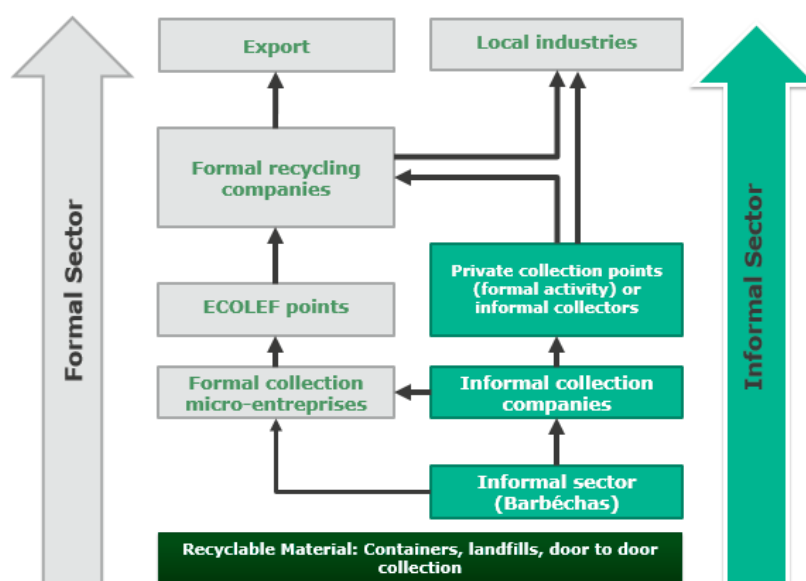


Figure 6. Material flow and the role of the informal sector.

Inserting this labor force into the “official” Tunisian economy could be of great help to this population in terms of social, health, economic, and environmental aspects.

3.7. Causes of Decreasing Collection and Recycling Rates

At the collection level, barriers relate mainly to the price offered by private companies not member by ECO-Lef, which create a concurrence with the system. In some cases, problems are related to the inability of some ECO-Lef points to accept the collected quantities due to non-congruence between the number of workers per point and the accepted quantities. Moreover, after the revolution, municipalities were asked to return their locals from ANGED without proposing any alternative. In addition, there is no structured manual and IT registration system (for the acceptance and distribution of the quantities) in place to organize the system. In practice, management of the collected quantities and their distribution is performed manually. Furthermore, the absence of a field follow-up and control of the system represents a barrier to development. At a central level, the lack of human resources presents a problem in ensuring all the requested tasks are performed.

At a recycling level, the quantities collected in 2017 have declined, leading to many complaints by the recycling companies contracted with ANGED. The distance also represents a barrier to the collection of stored quantities in some ECO-Lef points by the recycling companies, such as those in Medenine in the south of the country. The costs of transporting the material also means the business is not profitable. Finally, the proliferation of non-approved recycling companies (informal recycling companies) renders the sustainability of small formal companies problematic.

4. Discussion

4.1. Proposed Organizational Model for SWM in Tourism Zones in Tunisia

This research shows that the problem encountered by tourism municipalities in Tunisia is mainly caused by the lack of organization between different actors, a lack of financial resources, and the absence of planning, which itself is caused by the absence of data and is a key requirement for making good decisions. One key barrier is that of centralized decision-making, where there is no involvement of citizens and local actors. After the election of May 2018, local authorities (actually 350 municipalities) held a greater number of decision-making powers. To improve the level of SWM in tourism destinations in Tunisia, all actors and stakeholders should be involved so that each can contribute to the cleanliness of the zone.

In this paper, a proposed alternative APAL model for the provision of SWM in tourist destinations in Tunisia is presented. The model shown in Figure 7 depicts the involvement of all stakeholders in most SWM procedures. Municipalities would be the main actor involved in managing solid waste; however, in terms of its implementation, the local government should cooperate with national authorities (tourism and environment ministries), the private sector (hotels, collection, sorting, and recycling companies), NGOs, and local citizens to formulate policy and create an appropriate SWM system.

The roles of stakeholders should be clearly defined as follows:

- (1) The central government (Ministry of Local Affairs and Environment, Ministry of Tourism) should play the role of a policy supervisor and financial supporter. Their tasks could include formulating national policies, standards and strategies, as well supporting municipalities by providing the knowledge and budget to facilitate their activities. The central government should coordinate its activities with related agencies such as ANGED, International Center for Environmental Technologies of Tunis (CITET), Protection and Coastal Planning Agency (APAL), and so on.
- (2) Environmental agencies (ANGED, APAL, CITET): their role includes developing a suitable legal framework to improve the sustainability of the sector. National Waste Management Agency (ANGED) is currently playing an important role in waste treatment and in supporting recycling and valorization initiatives. It should also support this sector through the implementation of an EPR system, which will ensure sustainable financing of SWM in Tunisia. ANGED should

also continue raising awareness among NGOs and citizens in tourism areas. The mission of the International Center for Environmental Technologies of Tunis (CITET) is to support tourism establishments through education and technical support programs to improve their internal SWM system. CITET should also have sophisticated laboratories available enabling it to push for scientific research, especially with regard to transferring its experience to the composting of organic waste. APAL should continue playing its role in supporting tourism municipalities to keep beaches clean during the year. They should also take charge of sensibilization and communication with visitors to beaches.

- (3) Municipalities should play their role as a policy maker at a local level, taking into consideration the national strategy and standards. The formulation of policies should be developed in concert with the private sector, society/citizens, and local NGOs. In addition, municipalities should retain the role of public service provider through the collection and transport of collected mixed waste. To encourage the waste producer (principally hotels) to minimize generated waste and reduce mixed waste, incentives should be applied to the collection of recyclable materials.
- (4) SWM private sectors represent the public service partners playing their roles as solid waste service providers and policy formulation partners.
- (5) Society/citizens and local NGOs represent a key partner. They should be engaged in policy formulation and implementation, control the management process, and cooperate in the provision of services. Local citizens are requested to participate in local efforts to sort the generated waste at source and coordinate with local NGOs and local governments.
- (6) Hotels and other accommodation establishments: In addition to its role in financing the municipality's services and the fund for tourism protection, these businesses should participate in local efforts to reduce the amount of waste generated by waste sorting at source. These efforts would also support local recyclable material collection companies. Tourism establishments should also contribute to the municipality's efforts to clean beaches regularly.
- (7) The Tunisian Federation of Hotels: This is a key actor in this process. It should participate in the development of local strategies related to SWM in tourism areas through participation in the organization and control of the SWM process. It should therefore be involved in the decision-making committee managed by the local government, especially when planning relevant actions. The Tunisian Federation of Hotels represents the link between local hotels and the municipality. In addition, it actively proposes and develops targets to ensure sustainable tourism areas related to SWM exist. The targets proposed should have a clear vision and objective.

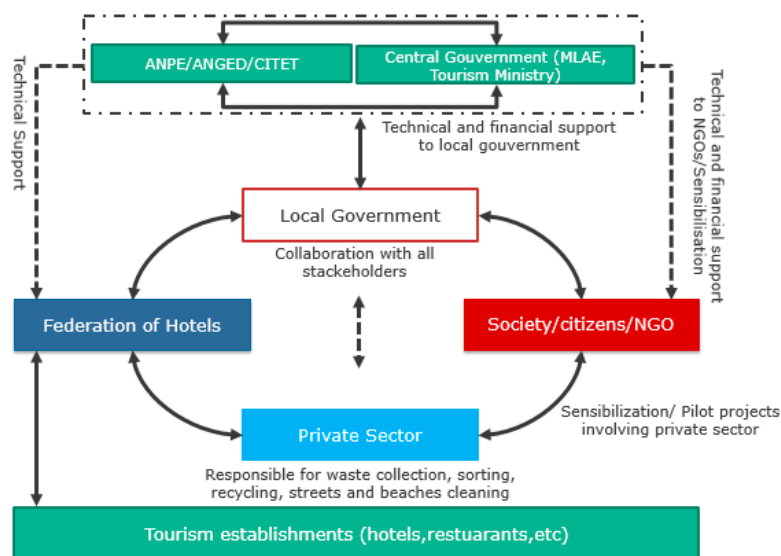


Figure 7. Proposed scenario for SWM organization in tourism destinations.

Figure 8 presents an overview of the recommended organization of SWM in tourism in Tunisia.

Role of Actors	Central government	<ul style="list-style-type: none"> - National policy and standard - Financial support to local government 	Policy supervisor and financial supporter
	ANPE/ANGED/CITET	<ul style="list-style-type: none"> - Technical support to hotels, FTH - Control and follow up of the process. 	Policy supervisor and technical supporter
	Local government	<ul style="list-style-type: none"> - Formulate policies in concertation with other partners - SWM service in the tourism destination 	Policy maker Service provider
	Private sector	<ul style="list-style-type: none"> - Policy partner - Service provider and operating following the standard 	Service provider and partner
	Society/citizens/NGOs	<ul style="list-style-type: none"> - Partner in the SWM process (respecting laws, sorting at source) - Developing pilot projects 	Partner and beneficiary
	Federation of hotels	<ul style="list-style-type: none"> - SWM strategy development – main partner - Coordination and control of the SWM process - Decision making main partner 	Key partner
	Hotels	<ul style="list-style-type: none"> - Waste sorting at source - Support the effort of the municipality (beaches and streets cleaning) - Coordination with FTH 	Partner and contributor

Figure 8. Role of different partners for SWM in tourism.

In addition to the commitment of all stakeholders, achieving the goals of this partnership should be supported by the following actions:

- (a) Raising awareness and changing the attitudes of public and industries towards SWM through the implementation of environmental education programs. The latter should focus on waste minimization, waste sorting at source in households and hotels, and the storage of waste in good conditions. Planning for education and awareness campaigns should consider national and local objectives, the target population, and the overall framework and socio-economic factors to ensure greater effectiveness.
- (b) Based on the Three Rs (3R) approach, the prevention and minimization of solid waste is the best way to manage waste, reduce landfilled waste, and thus reduce SWM costs, including the costs of waste recycling, transportation, and disposal/treatment. For this reason, waste reduction and prevention should be the highest priority when formulating SWM strategies in tourism destinations.
- (c) Waste recycling and composting: To motivate tourist establishments and local citizens to ensure the correct sorting of recyclable materials, local collection and recycling companies in tourism destinations need to ensure the correct collection and valorization of the generated waste. Cooperation between waste generators, collection and recycling companies, and other actors should be convenient, inexpensive, and with fewer barriers for all partners. In addition, the local government and private sector should implement pilot projects for composting green and clean kitchen waste. Education and exchange programs should also be implemented.
- (d) Role of the private sector: SWM programs should be developed between the private and the public sector (in the framework of a public–private partnership, PPP). The formulation of contracts is an important factor that will help ensure the success of this partnership. Collaboration of the public sector should involve not only large or international companies but also the local private sector, micro-enterprises, and local engineering offices.

- (e) The integration of the new concept with the national vision and projects: The organization of the new concept should take into consideration the national vision and orientations. For example, in Tunisia the valorization of materials through the mechanical–biological treatment (MBT) is currently a key aim.

4.2. Importance of the Optimization of the ECO-Lef System in Tunisia

Securing long-term financing for SWM measures is the most important basis for investment in the field of SWM. This especially applies to the construction and use of the required collection logistics as well as the construction and operation of facilities. Since the existing ECO-Lef system in Tunisia is insufficient, alternative forms of organization and financing are needed. Optimization of the ECO-Lef system can have several positive outcomes, such as reducing the burden on the public budget, contributing to job creation, reducing waste disposal (landfill), and increasing recycling.

In addition, fee-modulation can increase reuse and recycling, packaging optimization and prevention. For example, fees and the calculation methods that underpin them have significant potential to influence product design. EPR schemes can promote technological and organizational progress and support the development of markets for secondary raw materials, which in turn creates new economic opportunities. Furthermore, recycling reduces CO₂-emissions along with water and energy consumption, which represents an important contribution in a future circular economy. Financially, full cost coverage of EPR can be achieved by ensuring that the fees are paid by producers to cover all the costs of collecting, sorting, and processing packaging waste.

Possible Scenario for a Future EPR System in Tunisia

Creation of the system operator: A new system operator needs to be established, particularly for packaging waste from households. The operator could also cover other forms of industrial and commercial packaging waste, which should be distinguished through targets and reporting. All types of packaging in the chosen category (e.g., all packaging sold to private consumers and perhaps the defined final user, no matter what the material or size) should be included in the system even if there is, as yet, no collection or recycling. Otherwise, the production of recyclables will be rewarded by not paying a fee. There has to be an exact definition and, in support, a list for the correct assignment.

A single not-for-profit organization is highly recommended at least when starting with EPR on a private level. The operator could be in the hands of the obligated companies. They should become shareholders or at least members (by contract and the payment of fees). Other companies in the supply chain could become shareholders/members on a voluntary level or could be involved as guarantors for the recycling of their specific material. The system operator should follow—as part of its purpose—a public service mission regarding the collection, recovery, and recycling of household waste.

ANGED: The Tunisian National Waste Management Agency is actually taking on the responsibility of being an operator for the current ECO-Lef system. In the proposed system, the system operator will assume this responsibility. The role of ANGED should then become that of controlling and monitoring the system operator. ANGED should also define the key objectives in term of collected materials, recycled materials, and recycling rate. These objectives should be based on the existing infrastructure and available means, and on indicators. The agency will also serve as a partner in developing the contracts between the system operator and private collection and recycling companies.

Responsible producers: The interface for the responsible producer should be defined exactly so that no focused packaging falls out of the EPR system and a clear identification should be fixed. Obligated companies are those that are the first in the supply chain in Tunisia to put packed goods on the market. These goods are used in Tunisia, where the packaging is most likely to be disposed of. These companies must finance the EPR system and pay the fees as:

- producer/filler for the sale of their packed goods in Tunisia and,
- importer of the packed goods in Tunisia.

Exemptions for producers, fillers, and importers who place a smaller amount of packaging on the national market can be considered, however the conditions for the exemptions have to be defined.

Registration of the producers: To enable a system operator to engage in reliable planning for both the costs and the disposal, and to exclude free-riders, it is best to have no exceptions for household packaging or only very limited exceptions that are clearly defined.

The obligated producers should not gain an unfair advantage over their competitors or avoid their responsibilities by choosing one or other of these mechanisms. Registration, surveillance, and a detailed reporting system is absolutely necessary for self-compliance solutions.

Costs of the SWM operations: The fees should be calculated based on the net costs of collection, sorting, and recycling/valorization in relation to the respective material (full cost responsibility) and should also include further costs such as awareness campaigns and other defined tasks. The fees should be transparent and publicly available (especially in the case of a monopoly). The fee for each obligated company should be calculated based on the amount and type of packaging-material placed on the Tunisian market. Furthermore, the fees should incorporate an incentive to invest in green product design. For example, the actual recyclability of the packaging should be taken into consideration in the pricing.

Collection system within the new EPR concept: Sorting at source is a necessary step in implementing an EPR system for packaging in Tunisia. See Figure 9.



Figure 9. Sorting at source and the share of responsibilities.

Through sorting at source, the responsibility for the collection of the mixed waste currently ensured by the municipality is shared with private sorting and recycling companies (recyclable material). Currently, municipalities in Tunisia lack experience and expertise, and the infrastructure required to support sorting at source is limited. This operation would reduce the pressure on municipalities (costs, logistics, human resources, and space) and create new opportunities (jobs, businesses, and EPR system development).

A decision has to be made as to whether separate collections shall be available nationwide, perhaps in different types of collection systems and in defined steps. At the very least, the system operator should demonstrate, through a SWM plan along a timeline, the steps that will be taken to reach this goal. The collection points under the ECO-Lef should be integrated into the new collection system. A bring it yourself system should be combined with door-to-door collection projects. Anyone who is allowed to use this separate system should also ensure that the recycling targets are only achieved with the packaging allocated to the system operator.

Informal sector involvement: The informal collectors could receive incentives that would motivate them to organize themselves (associations). These associations could become contractors with the system operator. Another option could be the involvement of the informal sector in the official system,

through education and the registration in the social security system. The involvement of this important actor is considered a key factor in the success of the EPR system in Tunisia.

Role of the municipalities: The role of the municipality and the need for coordination with the system operator should be clearly defined. Since municipalities in Tunisia are very differently equipped and the necessary waste management services cannot be provided in the same way, it is recommended that the task of collection is basically organized by the operator. There could be an obligation to contract with a municipality if they show they can provide the services (on a standardized cost level) or the municipalities could take part in a call for tender, like the private companies. Municipalities and the system operator could also co-operate in local public communication and awareness programs.

5. Conclusions

Proper SWM is an important element in supporting the role of the tourism sector in the national economy. Discussions with tourists and visitors has shown that they are seeking an intact environment free of garbage in the roads and beaches or floating in the sea, which confirm the idea reported by [14].

In practice, the SWM role played by the national and local government involves the collection, transportation, and landfilling of waste, while citizens and the tourism industry establishments (hotels) are in charge of paying a service levy. Due to the rapidly increasing volumes of solid waste that are generated and accumulated in tourism destinations, municipalities in Tunisia spend a lot of money and effort ensuring a clean destination, mainly for waste collection. It is likely that more money will need to be spent on tackling this issue if SWM in tourism areas is not carried out in an effective and proper manner and if no efficient and sustainable SWM practices are put into effect.

This study agrees with the findings of [18], that a collective effort from all concerned parties is required to ensure a fruitful SWM system in tourism destinations in Tunisia. Such a system should consider both economic and social aspects. To achieve this target, an integrated approach should be considered. Integrated thinking for the recovery of materials is the key to a SWM system that can transform the waste in the tourism sector from being the source of environmental problems to becoming a solution. In the new model, both national and different local stockholders in Tunisia should play an important role in improving the cleanliness of their cities and sharing the pressure. The position of local society and industries in this model is considered as both a public service customer and an active public service partner.

Furthermore, to make substantial progress towards sustainable SWM in tourism destinations in Tunisia, it is necessary to propose and develop concrete targets. The proposed targets should have a clear vision and objective and be designed with clear indicators. However, these can be adapted anytime to changes in the framework. The implementation of the model requires the consideration of environmental, social, and economic aspects. In so doing, it will create a SWM system that is environmentally sound, economically viable, and socially beneficial.

Additionally, securing long-term financing for SWM measures represents an important basis for investments in the field. This applies in particular to the construction and use of the required collection logistics as well as to the infrastructure and operation of facilities. In Tunisia, alternative forms of organization and financing are needed to ensure a sustainable concept.

Developing an EPR concept will play an important and key role in addressing waste problems and in setting up recycling structures. The concept of EPR is a policy principle designed to promote the environmental improvement of products and manufacturing systems [33]. The foundation of an EPR system in Tunisia must be defined by law. This legal framework must consider the current situation as well as the specified objectives, which should be attained by an EPR system for the packaging market and in relation to the disposal of packaging.

The different situations and very different political objectives in individual countries means that every law and every EPR system is also different. Individual elements can be compared; however, even best practice recommendations can only be formulated under a specific objective. Thus, the following principles should be applied when designing and implementing EPR systems in Tunisia:

- the provisions in the law must be unambiguous and implementable;
- the obligated parties and their obligations must be clearly stated and specifically identifiable;
- the execution must be regulated so that the obligated parties cannot withdraw;
- clear regulations must be provided for all areas for monitoring and execution.

All areas of decision-making must be discussed politically and be socially acceptable, feasible to implement, and economically and ecologically sound. This challenge requires fundamental preparation and discussion with all stakeholders.

This study has shown that the development of an EPR system should be based on a participative approach with different stakeholders in the sector. Negotiations will guide the working team to select the concepts that fit best with the national and local situation. An EPR system should be adapted to the situation of each country and its specific characteristics. The optimization of or change to an existing system always remains a difficult task, since it requires an optimization on different levels, such as re-thinking, laws, organizations, etc. An EPR should be implemented through clear legislation and should create well-working cooperation between governments, producers, and waste management organizations.

Both tourism and hospitality establishments play a critical role in achieving sustainability goals in tourism destinations. The growth of these sectors translates into an important responsibility; each of its stakeholders has to ensure the creation of a sustainable environment for residents and visitors alike.

SWM authorities in the MENA region and especially in North African countries are trying to develop the sector, from the collection to the treatment, based on international practices and experiences. At the moment, they spend a lot of effort (financially particularly) to ensure clean cities, and to avoid social and political problems resulting in the mismanagement of waste.

In addition, most North African countries are just discovering EPR concepts and their benefits. The project aims at optimizing the current system in Tunisia, which represents a good experience to support the new concepts in the MENA region. This paper represents the first communication of the concept, and its benefits to the different cities, highlighting its benefits to tourism municipalities and destinations.

However, this study also has some limitations that need to be addressed. First, it presents the possible EPR scenario after discussion with stakeholders and does not include figures on the possible financial system. Second, the article does not link the proposed scenarios with technical solutions.

However, in this paper, new lines of research are opened in the area of SWM in tourist regions in Tunisia, such as the discussion of possible collection and sorting systems and possible technical solutions related to the organizational and financial solutions proposed.

Author Contributions: Conceptualization, W.C., A.N., S.B. and A.B.; methodology, W.C., A.N. and S.B.; validation, S.B., A.N. and A.B.; formal analysis, W.C.; investigation, W.C.; data curation, W.C., S.B. and A.N.; writing—original draft preparation, W.C.; writing—review and editing, W.C., A.N. and S.B.; supervision, A.N., S.B., A.B. and M.N.

Funding: This EPR project is co-financed by the Federal Ministry for Economic Cooperation and Development (BMZ) as part of the develoPPP.de program. It was implemented as a Development Partnership with the Private Sector (DPP) by the German Corporation for International Cooperation (GIZ) and the partner companies Cyclos GmbH, Envero GmbH, and RETech e.V.

Acknowledgments: We would like to thank all national authorities in Tunisia, municipalities, hotels, and private and public institutions that supported us in making possible the data collection that forms the basis of this paper.

Conflicts of Interest: The authors declare no conflicts of interest.

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