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(De)construct for Circular Economy

(Des)construir para a Economia Circular

WP 1 – Baseline situation analysis and follow-up

Activity 1.4 – Methodology for estimating CDW illegal dumping

Final report

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Promotor: cimbal – COMUNIDADE INTERMUNICIPAL DO BAIXO ALENTEJO

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1. Introduction

The main objective of the **(De)construct for Circular Economy [in Portuguese: (Des)construir para a Economia Circular]** project is to promote a regional strategy for the reuse of building products and components as well as the recycling of construction and demolition waste (CDW), thus reducing the environmental impact of the construction sector and promoting its circularity.

CDW illegal dumping is an important challenge to Portuguese municipalities since they must deal with CDW management in their territories. On one hand, it is common that municipalities do not have information about this issue: they know that there is a problem in terms of environmental impacts and visual degradation of the territory, but they do not have enough data to quantify it. There is also a knowledge gap about the level of management costs that they have or may have in order to support the CDW illegal dumping removal, namely with their own human resources and equipment (FCT NOVA & 3Drivers, 2020; Martinho *et al.*, 2013). On the other hand, there is a loss of recyclability potential for unused CDW, not allowing the reintroduction of these materials, recycled, in the construction sector.

This may happen mainly because: there is a lack of information or knowledge of small construction companies (FCT NOVA & 3Drivers, 2020; Ramos & Martinho, 2017); CDW facilities are not homogeneously distributed in Portugal, being this opinion corroborated by the main stakeholders involved in the CDW and construction materials value chains (Deloitte *et al.*, 2017); there is also an economic factor related to the payment for CDW recovery/disposal to waste management operators; inhabitants (individuals) behavior; among other reasons.

Within this background, the Work Package (WP) 1 – Baseline situation analysis and follow-up – led by IP Portalegre, includes two specific activities related to the CDW illegal dumping monitoring in *Baixo Alentejo* region, being FCT NOVA (Nova School of Science and Technology from NOVA University) in charge of its implementation, namely in what regards the development of a specific methodology for CDW illegal dumping estimate (activity 1.4) and CDW illegal dumping assessment, during the project (activity 1.5).

This report´s main goal is to present the methodological approach to be followed during the CDW illegal dumping monitoring, where it is important to obtain data for the current situation, but also to understand its evolution regarding the implementation of the strategic action plan for the *Baixo Alentejo* region (*e.g.* CDW illegal dumping sites and quantities reduction). Moreover, it may be possible to understand if some actions related to the project, for example the WP 7 participatory actions – Information, awareness and training –, have some immediate effects. This is the reason why a monitoring period during the project is necessary.

As mentioned, this document intends to present the methodology that will be followed and, in this context, the report is structured in the following chapters:

- Introduction (current chapter);
- Monitoring work criteria (chapter 2);
- Monitoring related data (chapter 3);
- Municipalities involvement and responsibilities (chapter 4);

- Schedule and deliverables (chapter 5);
- References.

Although it was planned to implement the CDW illegal dumping monitoring only in *Baixo Alentejo* region (activity 1.5), partner CNPCD (Romania – RO) proposed to join this activity, monitoring CDW illegal dumping in Timisoara municipality.

This is the final version of the report, after been evaluated by the WP 1 project partners, in order to obtain feedback for readjustments and taking into account the project objectives.

2. Monitoring work criteria

2.1. Main considerations

This chapter presents the monitoring criteria for CDW illegal dumping evaluation in the municipalities of *Baixo Alentejo* region, considering the following topics:

- Territory;
- Periodicity;
- Data collection;
- Complementary data.

Detailed instructions about the monitoring work will be given to municipalities in the following terms (see also chapter 5):

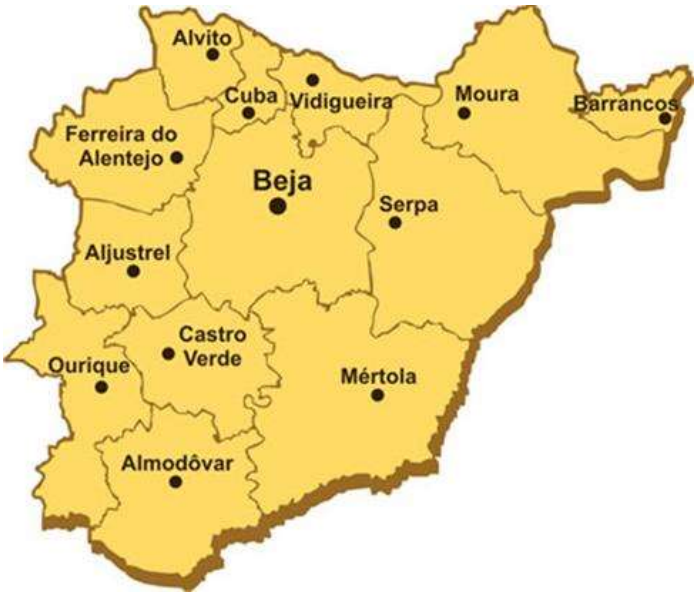
- One meeting with all *Baixo Alentejo* municipalities will be held/replicated during February, with a small number of municipalities at each time (two to three municipalities);
- Annex I contains generic instructions regarding the CDW illegal dumping monitoring work and will be explained in detail in the meetings above mentioned.

In what regards Romania, Timisoara municipality will follow the monitoring criteria mentioned in this report (*e.g.,* periodicity, data collection criteria, deliverables contribution).

Also, and in the near future, it should be considered the beginning of the strategic action for the *Baixo Alentejo* region proposal development (WP 6). A possible option is to contemplate data filling about CDW management and CDW illegal dumping monitoring directly through a digital system (*e.g.,* mobile phone, notepad), and then mapping the CDW illegal dumping using a Geographical Information System (GIS) tool.

2.2. Territory

To understand the reality of CDW illegal dumping, the monitoring work is conducted during the project considering the municipalities of *Baixo Alentejo* sub-region, that is part of *Alentejo* region in Portugal. This territory has 8 545 km², corresponding to 10,8 % of Portugal area, including 83 parishes organized in 13 municipalities (Figure 1). In this region, the average area of parishes is 102,9 km², much higher than the national average (21,7 km²). The population density of *Baixo Alentejo* region corresponds to 14,8 inhabitants/km², a much lower value than 109,9 inhabitants/km² for Portugal mainland (CIMBAL, 2021). These characteristics are relevant in what regards to CDW management issues, namely the distance and costs for the CDW transport to the licensed facilities for CDW recovery. In this context, a monitoring work is proposed for each of the 13 municipalities, namely: *Aljustrel, Almodôvar, Alvito, Barrancos, Beja, Castro Verde, Cuba, Ferreira do Alentejo, Mértola, Moura, Ourique, Serpa* and *Vidigueira.*



Source: CIMBAL, 2021

Figure 1. *Baixo Alentejo* region municipalities.

In Romania case, Timisoara is the third most populous city in Romania, located in the West of the country. In terms of surface, it has 130,5 km^2 (1 570 km^2 for the metropolitan area), with 319 279 inhabitants (according to 2011 Census), so the population density is 2 447 hab./km², a very different reality if we compare to *Baixo Alentejo* region.

2.3. Periodicity

Each municipality must register, on a monthly basis, the amount of CDW illegally disposed in their territory, specifying the sites where it happens, from March 2021 until, at least, April 2022. It is considered that some of these periods can be adapted with the formal consensus of the project partners and the involved stakeholders during the project duration.

Although the data collection period is expected to be made on a monthly basis, there will be three periods of data evaluation, with associated reporting, namely (see also the planned schedule in chapter 5):

- From February to March 2021 (two months, considering the period for municipalities meetings and to put into practice the CDW illegal dumping monitoring criteria);
- September 2021; and
- April 2022.

2.4. Data collection

The CDW illegal dumping in each municipality must be estimated in a monthly basis and in volume (using, for reference, 1 m^3 big-bag, or a 6 or 8 m^3 trapezoidal metallic container for CDW collection and storage). The

records must be carried out, discriminating the quantities by code of the European List of Waste (ELW)[1], or by type of CDW.

To convert the estimated quantities (in volume) into weight, the density of the different types of CDW should be used, per ELW code, as shown in Table 1. This list is intended to be indicative, since the density associated with each ELW code may vary depending on waste characteristics (*e.g.,* mixtures of waste).

Table 1. Density for common types of CDW.

ELW code		Density (ton/m^3)
17 01 01	Concrete (or reinforced concrete)	2,0 (2,5)
17 01 02	Bricks	1,3
17 01 07	Mixtures of concrete, bricks, tiles and ceramics	1,8
17 02 01	Wood	0,6
17 02 03	Plastic	0,2
17 03 02	Bituminous mixtures	2,5
17 05 03*/04	Soil and stones (containing hazardous substances)	2,0
17 06 04	Insulation materials (mineral wool)	0,05
17 06 05*	Construction materials containing asbestos	(13 kg/m^2)
17 08 02	Gypsum-based construction materials	0,2
17 09 03*/04	Mixed CDW	1,5

Note: *the values were gathered through data provided by technicians from construction companies and waste management operators, considering the most frequent values used. In the case of construction materials containing asbestos, specifically for cement tiles containing asbestos fibers, it was assumed that each tile has 2 m^2.*

For CDW illegal dumping monitoring, the recommendation is to carry out a photographic record every time each site is visited, to find out differences between monitoring periods or CDW classification. If the same area contains several types of CDW, representative photographs must be also taken.

The data collection must have into account the data filling in the template format presented in Annex II, that will be presented to the municipalities, and in a *Microsoft Excel* sheet, to facilitate and to harmonize data collection for different municipalities.

[1] *European List of Waste (ELW): Commission Decision 2014/955/EU, of 18 December, amending Decision 2000/532/EC on the list of waste, pursuant to Directive 2008/98/EC of the European Parliament and of the Council.*

2.5. Complementary data

A data set should be considered for the performance and monitoring indicators about the CDW illegal dumping calculation (see Table 2, but also subchapter 3.2), which will be collected in other WP 1 tasks or, if it is not possible to obtain it in time, during the implementation of the activity 1.5 itself.

This information will be more important regarding the periods of September 2011 and April 2022, after CDW illegal dumping monitoring has been established in the region, with some months ahead, so it can be possible to calculate monitoring indicators.

Table 2. Complementary data to be considered within the CDW illegal dumping monitoring.

Data type and description		Objective
CDW illegal dumping	– Data about CDW illegal dumping in the last 5 years (2016 to 2020): number of sites, quantities, costs related to removal, others.	– Attempt to evaluate the situation before the implementation of the project and the activity 1.5 itself.
CDW generation and treatment	– Total CDW stored in drop-off centers (ecocenters), or similar spaces, by origin: i) delivered by citizens or constructions companies; ii) CDW illegal dumping removal; iii) municipal construction works; – CDW sent to waste management operators (including quarries, for environmental rehabilitation/backfilling[2]).	– Attempt to assess the effect of implementing the project and specifically the participatory actions, on the CDW management, as well as assessing the effect and evolution of the situation of CDW illegal dumping in the region.
CDW management costs	– Costs related to CDW sent to waste management operators (collection, transport, disposal and fees); – CDW illegal dumping costs. (municipal direct costs or related to contracts with waste management operators);	– Attempt to measure and raise awareness about the effects of CDW management costs versus the costs resulting from the removal of CDW illegal dumping with the municipality own resources (human resources and equipment).
CDW information and awareness campaigns	– Number of information and awareness campaigns about CDW and related topics, as well, if possible, the contents, results obtained (or perception of the results obtained), and implementation costs.	– Attempt to assess the effect of information and awareness campaigns, especially regarding the CDW management in the region by small construction companies.
Construction sector dynamic	– Number of constructions works executed, by type: public works, private works and municipal construction works.	– Attempt to calculate performance and monitoring indicators to assess the situation regarding CDW illegal dumping.

[2] *Backfilling (definition from Directive 2018/851, of 30 May, amending Waste Framework Directive 2008/98/EC, of 19 November): any recovery operation where suitable non-hazardous waste is used for purposes of reclamation in excavated areas or for engineering purposes in landscaping; waste used for backfilling must substitute non-waste materials, be suitable for the aforementioned purposes, and be limited to the amount strictly necessary to achieve those purposes."*

3. Monitoring related data

Considering the experience with similar CDW related projects developed in Portugal (FCT NOVA & 3Drivers, 2020; Martinho *et al*., 2013), it is important to understand the costs related to the CDW illegal dumping removal, since few municipalities present this type of data. Considering that this is an important content to evaluate, a methodological approach is presented in this chapter for those municipalities where this information does not exist or is not possible to obtain (see subchapter 3.1).

Furthermore, a group of performance (and monitoring) indicators is also presented in this chapter, so it can be useful not only to make the diagnosis of the current situation, but also to try to evaluate the results within the project (see subchapter 3.2).

3.1. Costs estimate

Through similar works already developed in Portuguese municipalities and regarding CDW management (NOVA & 3Drivers, 2020; Martinho *et al*. 2013), it was identified that it is not common for municipalities to have data related to the costs about CDW illegal dumping removal, at least in a systematic way, and bearing in mind that the majority of the CDW managed by the municipalities are mixtures (ELW 17 01 01 or 17 09 04 – see Table 1). In this context, it is usual that municipalities assume the costs through contracts with waste management operators (removal/transport, treatment and fees) or with its own means (human resources and equipment), with relevant municipal budget effects.

Firstly, and although being aware that this approach should only be used in the absence of real data to estimate reference costs related to the CDW illegal dumping removal, it is necessary to establish, together with the municipalities involved, the following unitary reference costs/values for *Baixo Alentejo* region:

- Human resources: average number of workers per CDW illegal dumping removal action; average hourly cost per worker;
- Equipment: type of equipment used in CDW illegal dumping removal actions; average hourly cost by type of equipment.

Secondly and in order to estimate the global reference cost for the municipality with the removal of CDW illegal dumping, it is important to consider three components:

- The average cost with the CDW illegal dumping removal itself, considering the CDW loading time, per unit of volume/weight, but also considering the general cleaning actions for the entire site;
- The time and costs related to workers travels to the CDW illegal dumping site(s) (variable component, depending on the distance and number of sites), including also the signposting of the site, as well as the discharge of CDW in destination, which can be temporary (*e.g.* municipal drop-off center/ecocenter or similar place) or definitive (waste management operator). It is also necessary to consider the load capacity of the equipment used;
- In case of CDW unloaded at the municipal drop-off center/ecocenter or in a similar place, the cost of eventual CDW transport from this place to the final destination (waste management operator), as well

as the respective fees payment (deposition fee and environmental waste management fee), when applicable; in general (or in an absence of data case), the calculation should be performed in relation to the total CDW amount, as it is assumed that they are stored in a municipal drop-off center/ecocenter or similar place.

At the end, and if possible, the obtained results will be compared to the existing data (in municipalities with real data), so the methodological approach (accuracy of costs) can be adapted and/or validated according to the reality of *Baixo Alentejo* region.

3.2. Performance and monitoring indicators

Performance indicators, which also serve as monitoring indicators, in the second case to measure the effect of the project implementation, are presented in Table 3. In a short term, it will be made the attempt to evaluate the possible effect of the participatory actions with small construction companies on the reduction of CDW illegal dumping or on the amount of CDW received by municipalities.

Table 3. Performance and monitoring indicators.

Indicator		Unit	Reporting period
I.1	Monitored areas	n.º/municipality (also, by month, semester or year)	March 2021, September 2021 and April 2022
I.2	CDW estimated amount (volume)	m^3/municipality (also, by month, semester or year)	March 2021, September 2021 and April 2022
I.3	CDW estimated amount (weight)	ton/municipality (also, by month, semester or year)	March 2021, September 2021 and April 2022
I.4	CDW estimated amount, by municipality area	ton/km^2 (also, by month, semester or year)	March 2021, September 2021 and April 2022
I.5	CDW estimated amount, by construction work completed in each municipality	ton/work (type) (also, by semester or year)	September 2021 and April 2022
I.6	CDW cost related to illegal dumping removal in each municipality	€/work (type) (also, by semester or year)	September 2021 and April 2022

4. Municipalities involvement and responsibilities

In order to enable CDW illegal dumping monitoring, the involvement of the municipalities is essential, mainly through its operational representatives, that will be responsible for:

- Coordinating, directly with FCT NOVA, the development of the tasks;
- Establishing and coordinating, internally (in the municipality), the necessary efforts, in terms of human resources, so the CDW monitoring work can be done monthly and in the established schedule;
- Ensuring data collection (in the proper template) with the criteria established by FCT NOVA;
- Ensuring access, if existent, to the complementary data (see subchapter 2.5), allowing the calculation of the performance and monitoring indicators, especially in the second and third moments of the evaluation (at least 1 to 2 months prior to September 2021 and April 2022).

Meanwhile, a list of the representatives of each municipality was asked to the promotor of the project (CIMBAL), as presented in Table 4.

Table 4. Operational representatives of each municipality for the project (De)construct.

Municipality	Operational representative for the project (De)construct
Aljustrel	Elisabete Benedito
Almodôvar	Nelson Santos
Alvito	Marta Susano
Barrancos	Dalila Guerra
Beja	Rita Paiva
Castro Verde	Antonio Simões
Cuba	José Borracha
Ferreira do Alentejo	Bruno Arvanas
Mértola	Jorge Pulido Valente
Moura	Mónica Moscão
Ourique	José Vairinhos
Serpa	Hélder Victória
Vidigueira	Sara Romero Brito

In Romania, Aida Szilagyi will be the operational representative for the project (De)construct.

5. Schedule and deliverables

Table 5 presents activities 1.4 and 1.5 (WP 1) planned schedule, as well for related actions. Regarding this calendar, it is also important to take into consideration:

- Explanations on the involvement of all *Baixo Alentejo* municipalities in the planned monitoring work (which will start in March 2021), were presented during the meetings with the municipalities (February 2021);
- Although in activity 1.5 the data collection reporting is established for three specific periods, an effort will be made with the municipalities in order to allow CDW illegal dumping monitoring and reported in a monthly basis (these actions may depend on the evolution of covid-19 pandemic and related restrictions);
- Although it was not a project planned task , CNPCD (RO) will be responsible to collect data in Timisoara municipality, complying with the planned schedule and deliverables in relation to the activity 1.5.

Table 5. Schedule for the tasks related to the activities 1.4 and 1.5.

Activity			Year (months)																						
			2020				2021												2022						
			9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8
1.4	Methodology for estimating CDW illegal dumping																								
1.5	Estimate of CDW illegal dumping	Evaluation and reporting																							
		Monthly data collection																							

The schedule referring to the deliverables planned for the activities 1.4 and 1.5 from WP 1, as well as the respective deadline, are presented in Table 6.

Table 6. Deliverables related to activities 1.4 and 1.5.

Activity		Deliverables	Deadline (month-year)
1.4	Methodology for estimating CDW illegal dumping	– Methodology for estimating CDW illegal dumping report.	February 2021
1.5	Estimate of CDW illegal dumping	– Estimate of CDW illegal dumping report, at the end of each monitoring period.	March 2021 September 2021 April 2022

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ANNEX I – Instructions for CDW illegal dumping monitoring

Each municipality of *Baixo Alentejo* region will be in charge of data collection on CDW illegal dumping in its territory, with the support of FCT NOVA team, in respect to the following orientations.

Municipal responsibilities:

- Coordinating, directly with FCT NOVA, the development of the tasks;
- Establishing and coordinating, internally, the necessary efforts, in terms of human resources, so the CDW monitoring work can be done monthly and according to schedule;
- Ensuring data collection (in the proper template) with the criteria established by FCT NOVA;
- Ensuring the access, if existent, to complementary data, allowing the calculation of the performance and monitoring indicators, especially in the second and third moments of the evaluation (at least 1 to 2 months prior to September 2021 and April 2022).

CDW illegal dumping sites identification and monitoring criteria:

- Identification and registration of all the known sites with CDW illegal dumping;
- If a zone is constituted by more than one illegal dumping site (*e.g.* part of a street with 3 illegal dumping sites next to each other), it must be registered as 1 site;
- Each CDW illegal dumping site must have at least a photo associated in each monitoring period;
- If a site has more than one type of CDW, each type must be registered and quantified independently.

Monitoring periodicity criteria

- Each site must be visited on a monthly basis;
- Even if the CDW illegal dumping has been removed, the site must be visited in the next periods;
- New sites must be recorded and must be visited in a monthly basis after registration.

Data reporting

- Each municipality must report its data, for each CDW illegal dumping site, according to the templates presented in Annex II, that will be available in a *Microsoft Excel* format, for easier data filling, including (see Table 8):
    1. Site identification and complementary information (spatial coordinates, parish name, street name, land ownership, and notes; see Table 7, complementary to Table 8)
    2. Date of the visit;
    3. Type of CDW (according to the ELW or, if not possible, with an exact description);
    4. CDW quantification (if estimated, indicate the volume and transform it in weight, through the density of materials selected; if real, register directly the data in weight reported by the waste management operator);

5. Removal action (indicate if yes or no and, if yes, indicate the action date, the final destination of CDW – *e.g.,* waste management operator, quarry –, and the respective cost);
6. Picture(s) code (create a picture code for each CDW illegal dumping site);
7. Notes (if necessary, add notes about the monitoring work).

ANNEX II – CDW illegal dumping data collection template

Table 7. Data collection of CDW illegal dumping sites template.

Sites information						
ID	**Spatial coordinates**	**Parish name**	**Locality**	**Street name**	**Land ownership** (public, private)	**Notes**

Table 8. CDW illegal dumping data collection template.

1. Site ID (see Table 7)	2. Date (yy-mm-dd)	3. Type of CDW		4. CDW quantification				5. Removal action				6. Picture(s) code	7. Notes
								A. Removal?	B. If removed				
		A. ELW code (6 digits)	B. Description	A. Real or estimated?	B. Quantity (volume, m^3)	C. Density selected	D. Quantity (weight, ton)	Yes or No	I. Date (yy-mm-dd)	II. Destiny	III. Cost (€)		