

Waste Management Methodology for Small communities

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1. Introduction

This Deliverable is one of the outputs of Activity 3.4 of the NETWAP Project and it is related to the definition of a waste management methodology for organic waste and plastic management in small communities. This activity consolidates the realization of one of the outputs of the project. The definition of such a methodology is based on the application of the results of Deliverable 3.4.1 concerning the definition of a common framework methodology on waste management in small communities..

The methodology is aimed at defining a new approach for the autonomous and sustainable waste management in small communities and foresees procedures for:

- Biowaste management;
- Recycling of waste plastics collected from beach and marine litter

2. Biowaste management

2.1 Legislative framework

In the framework of the circular economy, the European Union (EU) has clearly set the steps for all its members, in order to progress towards an overall improvement regarding urban waste management.

The aim is to overcome the old conceptual model where waste were previously considered as refuse, and now become to be seen as a resource. First measures should include minimization and prevention, leaving as last options the energy recovery and landfilling of waste.

The EU has set through the Circular Economy Package (Directive 2018/851/EU), the obligation of managing separately the organic streams generated in the municipalities as well as organic domestic waste by following very precise delays and goals. The main objectives of the EU are:

- 65% of recycling by 2035
- Reduction of municipal waste landfill down to 10% by 2035

Furthermore the requirements for the organic waste are:

- Obligation to implement the separate collection or recycling at source (home, community and local/communal composting) of bio-waste by 31 December 2023
- Bio-waste that has not been separately collected/separated at source and treated through composting or anaerobic digestion, will not be counted as recycled as from January 2027

Also the Waste Framework Directive (Directive 2018/850/EU) added some key elements related to community and home composting:

- It equates composting with selective collection in terms of enforceability of managing bio-waste selectively.
- Composting is considered a (in situ) waste recycling activity (so it is confirmed that the idea of framing it as a bio-waste prevention practice should be ignored). Additionally, it means that the tonnes managed through auto- (home), community or local/communal composting must be included in the waste recycling concept in relation to the achievement of objectives
- Member States must take measures to foster and encourage auto- (home), community and local/communal composting (Article 22).

- Recycling processes through composting must ensure a high level of environmental protection and result in output which meets relevant high-quality standards. Such conditions must be also ensured for small scale composting practices.

2.2 Setting up of small scale composting

The municipal administration is the first actor for setting up initiatives of small scale composting. The major aim consists of stimulating a spirit of participation in people who can consider waste not as a refuse but a precious resource to be exploited for the good of the community. Therefore, the municipal administration is asked to promote as a first option home or autocomposting and community composting as these practices were described in detail in Deliverable 3.4.1. By adopting these two options, the municipal administration obtain as a direct advantage a drastic reduction of waste production and the cut off of services bound to waste collection and transport to waste treatment facilities. In fact, biowaste is retained and transformed into compost by the producers themselves, whether households or commercial operators (hotels, restaurants, campsites,...) considered as single subjects (in the case of home/autocomposting) or associated (in the case of community composting). However, the municipal administration can realise that its citizenship is not aware of this practice and need first to be properly guided in this new pathway. In this case the best solution consists of introducing the local or communal composting where people have the possibility to be witness of the transformation of biowaste into compost without taking the charge of managing themselves a composter, for which the municipal administration would remain accountable.

Now, we are going to show in detail the steps to be followed in case of introducing home and community composting. The municipal administration should establish a “home and community composting register”.

2.2.1 Home and community composting register

The Municipal register of home and community composting is the list of users who are ready to declare that they independently treat compostable biodegradable waste according to the provisions of a regulation issued by the municipal council. These users commit themselves by not giving their produced biowaste to the waste management service and access tax rebate provided by the Municipality in return.

2.2.2 Association bound to the community composting

The community composting must be set off and managed by a group of households and or commercial operators (typically economic and touristic operators like: restaurants, canteens, hotels, B&B, campsites, harbours,...) joined into an Association of private law. The municipal administration can do a survey of associations of volunteers, of citizens with a common hobby interest, consortia, real estates which is resident in the municipal territory, promoting this initiative. Here are provided some examples of association which can be eligible for such practice:

- a block of flats, with or without restaurants or hotels who join into a single Association.
- a consortium of small villas, already joined in a common administration where all owners pay for gardening services, etc.,
- an urban vegetable garden subdivided into small properties, whose owners decide to join into a single association.

- a voluntary association for environmental protection
- a hobby association of citizens

Prerequisite conditions for these associations are:

- the availability of a land property where to set the composter, manage the curing phase preparing the organic heaps, spread the produced compost as a soil improver;
- the appointment of a person accountable for the management of the composting (the composter itself, the quality of the operations, the curing phase, the usage of the compost)
- the presence of a written statute reporting the data of all members

2.2.3 Operation of the register

The register can include the following subjects:

- single households or single commercial operators who wish to set off the home (or auto) composting, transforming their own biowaste into a compost, using a domestic composter (as described in the annexes of deliverable 3.4.1) or an electromechanical composter;
- associations like the ones described in paragraph 0; these associations are supposed to treat a quantity of biowaste of some tons in a year, for which an electromechanical composter represents a proper solution.

All subjects (single users and associations) who were mentioned above, must be up-to-date with waste tax payments. Being enrolled into the register implies:

- The subscription of a Convention Scheme

- The filling and signature of an adhesion form;
- The properly carrying out of the home and community composting activity

The register can foresee the following categories of users:

Home or auto-composting

- a. Home composting for domestic users;
- b. Individual composting of agricultural and plant-nursery activities;
- c. Individual composting for non-domestic users;

Community composting

- d. Associations

The user who intends to cease the practice of home (auto-) or community composting is required to give prior cancellation by communicating the date of cessation. Consequently the user will be cancelled from the Municipal home composting register and will lose the benefit of the loss waste tax rebate .

the user must accept and make possible educational visits and / or checks carried out by the staff appointed by the Municipal Administration, through access to the area where the home composting practice takes place and where the container of undifferentiated dry waste is positioned home composting

2.2.4 Accountability of the associations which carry out community composting

The Association which set off an activity of community composting appoints a Responsible who represents the Association with the Municipal administration and authority. He is requested to possess the authorization released by the Municipality and provides any information about possible variation of the activity. The responsible communicates to the municipal administration the list of members of the association providing for each of them: the typology (whether household, or commercial activity), the number of components in case of households members, the estimation of treated biowaste. The last data give right to a reduction of the waste tax payments according to the same mechanism described for the home or auto composting (see 0).

2.2.5 Incentives

The municipal administration can promote the home and community composting by forecasting the following incentives:

- Provision of a domestic composter on loan which will be granted for the entire time of enrolling in the Register.
- Concession of a reduction/rebate in the waste tax, in consideration of the suspension of the collection service of the organic fraction. The amount of reduction/rebate tax will be established during the approval phase of the budget proportional to the reduction of the conferment of biodegradable organic waste to the waste collection service.

In order to recognize an incentive to households which carry out home composting, the municipal administration should consider the quantity of biowaste per household that is not collected anymore. In the deliverable a quantity of 80 kg of biowaste is conventionally produced by a single

person who belongs to the same household in a year. The total amount of biowaste which is produced by a household is the product of 80 kg per the number of household components. Therefore, the municipal administration save money for the collection of $80 \text{ kg} \cdot n$ for each household every year. If the user is a company which provide gardening services, agricultural and plant-nursery activities, or generally is a non-domestic user, the estimation of biowaste which is produced every year is carried out in the following way. One considers the total volume in liters of containers assigned to non-domestic users for home organic collection which is multiplied by the specific weight of biowaste (500 kg m^{-3}) and by the total annual number of container emptying from the municipal staff separate collection system. The overall estimation of the savings is given by the sum of the collection and treatment costs; the collection cost is in turn given by the product of the collection cost per kg by the total of biowaste treated by a single user in a year. The same system is adopted for the estimation of the treatment costs.

2.3 Local or communal composting

The local or communal composting consists of a composting directly organised and managed by the municipal administration or the accountable company for the waste management services. In this case the municipal administration takes in charge the management of a “small” composting plant provided with most but the input capacity of a larger industrial plant. The size of the plant is intended as the one provided by an electromechanical composter of tens of tons per year. Therefore, from a technical point of view, there is no difference with home or community composting which choose to manage an electromechanical composter. The municipal

administration can decide to share a part of the total biowaste production of its citizens with an external industrial plant with which establishes a contract. Conversely, in case of a very small village with a population equal or below 1000 inhabitants, the hypothesis of a single composter is realistic. Contrary to other approaches previously described, bio waste is delivered by the waste collection system and not by the producer. However, there are current cases, where the municipal council keeps a very high trusting relationship with its citizens and in which the municipal administration allows citizens to drop off themselves their biowaste in the composter, without the need of any collection system. In cases where the municipal administration keeps a contract with an external treatment facility, the benefit will be a reduction of the disposed biowaste. In Italy, the municipal administration is obliged to communicate the beginning of the activity to the regional agency for environmental protection receiving a positive opinion. In this communication a description of the composter with the operations bound to it, and the treatment of possible effluents (gaseous and or liquid emissions) is reported. The municipal administration must appoint one or more operators to manage the composter: they are known as “conductor”.

The resulting compost can be used by anyone, not only the producers, it can be sold, given for free or used as component of a more sophisticated fertilizer.. When the local composting is realised in an Italian village, this compost is considered as a soil improver and as such must comply with a specific list of physic-chemical properties reported in the Decree Dlgs 75/2010. These properties with their threshold limits are described in Table 1.

Table 1 . - Physical-chemical properties reported in the Italian Dlgs 75/2010 concerning the compost quality for local composting

Parameter	Threshold
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Moisture (%)	< 50%
pH	6-8.5
Total Organic Carbon (% dry weight)	>20%
Humic and fulvic carbon (% dry weight)	>7%
Total organic Nitrogen (% dry weight)	>80% Total Nitrogen
C/N	<25
Metals	mg/kg
Ni	100
Cu	230
Cd	1.5
Pb	140
Zn	500
Hg	1.5
Cr (VI)	0.5
Inert fraction	< 0.5%
Control on Salmonella and Escherichia coli	
Germination Index (30% dilution)	>=60%

2.4 Composting management

2.4.1 Operations manager/conductor

A responsible for 1) correctness of composting operations by electromechanical composter and 2) equipment integrity should be appointed. This person should attend a practical training course held by qualified experts and consequently receive a conducting licence. The operations manager is supposed to:

- receive and check the kitchen waste from users

- provide and prepare (by milling) a sufficient quantity of prunings to be used as bulking agent.
- preside over loading operations
- report any failure to the maintenance company

2.4.2 Management of electromechanical composter

The loading of the electromechanical composter may occur either by emptying large bins containing the loose kitchen waste, or by introducing compostable bioplastic bags filled with kitchen waste. In turn, these compostable bioplastic bags are available on the market with two types: 1) the first having a thickness below 50 micron, the employment of which consists of measuring the weight of fruits and vegetables on the market; 2) the second, having a thickness of 200 microns, more resistant, which is used to carry on heavy goods purchased on the market. The material of both types is biodegradable with times compatible of the existent conditions within an industrial composter. The European standard to which the compostable bags should comply is the EN 13432. When loading compostable bioplastic bags, it is advisable to pay attentions to avoid any clogging of the operations, possibly caused by the wrapping of bags around the rotating shaft. The risk is higher with thicker bags. If this occurs, it is advisable to load the composter with loose kitchen for some time, before resuming the normal operations. This inconvenience is easier to occur when the composter is provided with internal mechanical components in motion.

The composter is continuously fed. It consists of a single cylindrical chamber having a volume dependent on the input capacity which normally ranges from 1 to 130 t y⁻¹. A fan ensures ambient

air ventilation through the organic matter; exhaust air is sent to a biofilter for odour removal. The facility is provided with three thermocouples installed at three spots along the axis of the cylinder, in order to monitor the temperature of the composting organic matter. At the opposite side of the feeding system, an exit hole allows to the partially stabilized organic waste getting out and not accumulating in the chamber. A semi stabilized compost continuously comes out from the electromechanical composter due to overflow and is moved to a stockpile or heap where it undergoes a curing stage for more weeks.

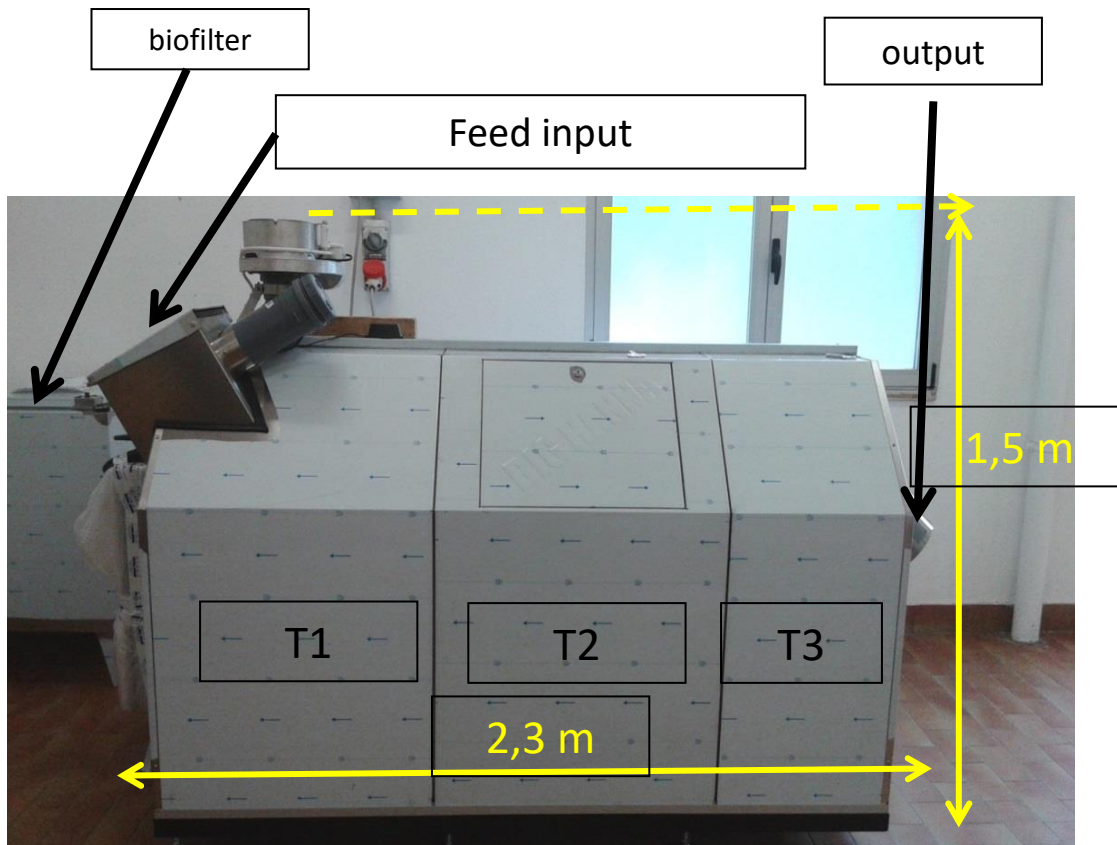


Figure 1. – Overview of an electromechanical composter

The electromechanical composter is daily fed with food waste (which can be 20-30 kg if the composter has an input capacity of 10 t y⁻¹) and 10% of the input food waste consistent of bulking material wood pellets or prunings milled to a size of about 5- 10 mm and lower. There are no restrictions to typologies of food that are allowed to be fed; one can feed: meat fish, vegetables, corn derived food. They must always vary: it is not allowed that the same food is introduced in the composter. It is possible to avoid to feed the composter strictly every day (one can avoid

Saturdays and Sundays for instance). It is sufficient that temperature does not go lower than 50°C in all zones of the composter at the same time. This can be the sign of insufficient feeding.

Just the start-up foresees the feeding of a larger quantity of bulking material, and specifically, tens of kg of wooden pellets. The manager of operations must ascertain that kitchen waste does not contain: any metal (forks, etc.) plastics, bulky waste, batteries, which can damage the composter mechanism and pollute the compost quality.

Moisture content should not go lower than 40%. One can measure it by taking a sample (10 -20 g) of the organic material inside the composter and putting in a thermal balance. If moisture is too high, add more bulky agent (instead of 2 kg, up to 5 or 10 kg) and stop for some time to add or reduce the quantity of kitchen waste. This can happen on summertime when very humid fruit is consumed. If moisture content is too low, then add water by a watering can.

The “Incubation period lasts about 7 to 10 days”. After this period, one observes that material inside the composter is transformed into a earthlike material very warm and humid. The process is correctly conducted if temperature in the central part of the composter is above 55°C. Usually the first two zones of the composter have a temperature above 40 °C and the last one near the output, lower than 40°.

After 30 – 40 days of continuous feeding, the first output comes out of the composter and has to prepare the stockpile. The semi-stabilized compost coming out from the composter during this period is put into a heap or stockpile protected inside a roofed area.

Curing phase

The stockpile/heap is prepared in a roofed area. Once a week the heap is turned manually (where the operator will use a shovel) to permit the air exchange and watered to adjust the moisture content if this became lower than 40%. It is advisable to measure temperature by a thermocouple connected with a temperature meter. One can expect that in the first months temperature goes higher than 50 °C. Curing can last up to three months until temperature inside the heap reaches a steady value close to ambient temperature.



Figure 2. – Curing phase

2.4.3 Management of domestic composter

Static composters are containers (usually made up of plastics) covered with holes (in order to allow the air exchange) and various capacities: from 400 to 1200 L. They can be installed in a covered area or in open air. In the first case it is advisable that they are mounted on wood pallet to let air comes in from the bottom. Insect proliferation can be avoided by applying a mosquito net around

the composter and adding a cover of dry leaves on to the most recent kitchen waste layer. Rotating composters are drums put in motion through the action of a crank handle. These are more effective with insects proliferation but they got filled with lower time than static composter.





Figure 3. - Domestic composters

It is advisable to start domestic composting in the warm season because ambient high temperatures promote the bio-oxidation process.

The static composter is daily fed with 2 kg of food waste and 0.2 kg of bulking agent. It is important that weight ratio between kitchen waste and bulking agent (pruning with size lower than 5-10 mm) is 10:1. Organic mass has to be periodically turned and watered (if moisture is lower than 40%). Moreover, in order to stimulate the enhancement of temperature and sustain the biodegradation process, it is advisable to pour fresh ground grass. A bottom layer made up of dried branches and leaves (about 25 kg weight) and adding cured compost as inoculum (about 11 kg weight) should be prepared. After six months of daily loading, open the small door at the bottom of the composter to withdraw the material. This withdrawn material is treated to prepare a stockpile

in a roofed area. Its temperature will not be high. One can expect that from time to time this has reached 40°C because bio-oxidation is less effective than with electromechanical composter.

Curing phase

The stockpile/heap is prepared in a roofed area. Once a week the heap is turned manually (where the operator will use a shovel) to permit the air exchange and watered to adjust the moisture content if this became lower than 40%. It is advisable to measure temperature by a thermocouple connected with a temperature meter. One can expect that in the first months temperature goes higher than 50 °C. Curing can last up to three months until temperature inside the heap reaches a steady value close to ambient temperature

3. Waste collection using low technologies in coastal areas

Plastics from beach or marine litter is associated with European Waste Catalogue (EWC) Number of 20 03 03 (residues from street and beach cleaning). On the other hand, plastic waste of municipal waste collection can be sent to a material recovery facility (MRF) only if it is classified under these EWC: 15 01 02 (packaging - including separately collected municipal packaging waste) or 20 01 39 (separately collected fractions - except 15 01). Nevertheless, whichever plastic item found on the beachside and included in the marine litter, can technically be recycled for the same reasons as waste plastic packaging collected by separate collection. Therefore, waste plastics from marine litter should be properly treated so that they can be sent to a MRF.

In fact, every initiative where volunteers, members of environmental friendly associations and even the waste collection service provide beach cleaning actions, waste plastics are not directed to recycling.

3.1 Best practice for prevention of waste production and marine litter management

The following procedure has been set to organise collection and valorisation of waste plastics collected from beach and marine litter.

1. The materials found on beaches have their own path, according to their composition and nature. Considering that, it is necessary to specify that the majority of beached debris are deposited along the coasts during sea storms.
2. Vegetable biomasses (wood, reed canes, seagrass wrack) should be prioritized to be retained on the beach to promote an ecological beach model. As second option, they should be moved to the backshore to protect the foot of the dune from wind, waves and storm surges
3. Waste should be removed periodically, thus insuring a clean environment that supports the conservation of ecosystems and pristine decorum of the coastal landscape. Waste of anthropogenic origin (plastics etc.) should always be collected before displacement of vegetable biomasses. Waste collection should be carried out manually by operators (volunteers or staff of companies responsible for collection), directly along the shores (both sandy and rocky). If the piles of marine biomass result in a large amount, waste separation can also be assisted by specific mechanical equipment.

4. Mechanized beach cleaning operation brings about the mixing of the waste with natural resources which in turn leads to the increase of urban waste production and prevent the sustainable use of beached vegetable biomass.

5. The mechanized cleaning of beaches should be regulated distinguishing natural and anthropized beaches, where roads, cliffs, sea-walls are extraneous elements; in these cases small temporary construction sites or the use of crawlers or wheeled vehicles would be useful for the separation of waste, beached biomass and sediment. This approach should be implemented in a manner that does not increase the anthropic pressure on the ecosystem.

6. In situ human use of beached plant biomass and sediment must not favor exploitation of natural resources but can generate many social, economic and environmental advantages. Therefore, due to the specifics of locations, a “case by case” approach should be undertaken for the assessment of sustainable management in accordance to National legislation. If the legislation is non-existent we propose it should be defined as soon as possible.

7. The collection of waste from coastal areas should be carried out manually in order to separate different types of plastics as well and increase the separate collection of plastics. Therefore, it is suggested to collect 3 categories of materials:

a. Nets used for mussel farming may be mechanically recycled according to the experimental treatment specifications outlined in Deliverable 5.1.3. has an EWC 20 01 39 code;

b. Other plastics, usually mixed and deteriorated, cannot be mechanically recycled, but must be treated according to the schematic description in Deliverable 5.1.3; for their management also this category has an EWC 20 01 39 code;

c. The remaining material will be classified as "residues from street and beach cleaning" with EWC code 20 03 03

8. Complementary services can include selective waste collection along the coast. Coordination of periodic cleaning actions operated by volunteers, associations and the services provided by local authorities that periodically collect and transport waste should be promoted. All events that involve volunteers should also include and promote the value of informal and non-formal education which can be implemented through these events.

9. During the cleaning events, volunteers and workers can drop off the material to "green islands" specifically distributed along the beach during the summer months, in order to avoid problems of EWC code attribution to the collected waste. Alternatively, operators can deliver the collected material to the nearest collection point or beach resort. Both the options described above could increase the percentage of separate/recycling collection of non-domestic users.

10. Volunteers should be trained to collect the different fractions of waste and separate them. If necessary, they may perform some preparation work such as washing or separation from the sand. Sediments must not be removed from the beach.

11. All sandy material and vegetable biomasses that should be recovered during the treatment must be separated, preserved and they are a common asset owned by the community and not by the management body of the treatment plant. Therefore, at the end of the process, they must be returned to the beaches with no cost for the public administration and without additional income for the owner of the treatment plant.

3.2 Concluding remarks

Enclosed to this deliverable some annexes that explain in detail the regulatory schemes of small scale composting and techniques of valorisation of plastics are reported.

In particular as far as the small scale composting is concerned the following annexes follow:

- 1) Facilities used in small scale composting
- 2) Regulation scheme for community composting to be issued by a municipal administration (in english)
- 3) Regulation scheme for local/communal composting to be issued by a Croatian municipal administration (in english);
- 4) Resolution of local composting regulation issued by Fossalto municipal administration (in italian);
- 5) Regulation scheme for autocomposting to be issued by a municipal administration (in english);
- 6) Vademecum for optimisation of marine litter prevention of beached waste production and management issues