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Zero-waste energy-efficient agricultural communities in the GR-NMK cross-border area - ZEFFIROS

DELIVERABLE 3.4

Analysis on legislation & certification for use of compost in agriculture

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Sub-Deliverable 3.3.4 – EU regulative and legislative frameworks for usage and quality assurance of compost and digestate and quality assurance in practice

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1. Introduction

In order to exhaustively address the issue of digestate, it is necessary to focus the attention on a broader horizon, i.e. the strategic framework in which it is included: Green Economy and Circular Economy.

The United Nations Environment Programme (UNEP) defined Green Economy as "a system of economic activities related to production, distribution and consumption of goods and services that result in improved human well-being over the long term, while not exposing future generations to significant environmental risks and ecological scarcities". Circular economy is instead a completely new model of production and consumption, defined by the Mac Arthur Foundation as "restorative and regenerative by design, where there are two types of material flows: biological, able to be reintegrated in the biosphere, and technical, to be recycled without entering into the biosphere".

The most recent development guidelines indicate that it is possible and necessary to use the limitated resources we have in an increasingly efficient and sustainable way, containing wastage as much as possible and optimizing the economic, environmental and social benefits.

In a perspective of optimal use of resources, the valorisation of waste from production cycles is a crucial aspect, in terms of culture, in order to move from a linear consumerist paradigm to another one, that is respectful towards circular economy.

Biogas production cycles, based on anaerobic digestion of residual organic materials, both from agriculture and urban origin (BOFSUW), fit perfectly in this new economic strategy. In both cases, material flows are intercepted – before they become waste – in order to be reused for energy production and finally be reintegrated in the biosphere.

According to the European Commission, at the present time, only a limited amount of waste produced in the EU is being recycled (43%), while the rest goes to landfills (31%) or is being incinerated (26%). It was estimated that it would be possible to recycle or reuse 600 million more tons of waste. The Directive No 2008/98/EC establishes that by 2020, 50% of biodegradable organic waste collected from households should be differentiated and treated in order to be reused in other ways. Moreover, the new proposal of the Waste Directive of December 2015 sets even more ambitious objectives, moving to 65% by 2030 the recovery target (reuse and recycling) of urban waste.

In order to better understand how digestate could be used in a proper manner, it is necessary to analyse the current regulation, considering in particular the distinction between waste and by-product. In fact, in the broad category of biodegradable wastes, including organic waste, often risk to enter huge amounts of agricultural and forestry residues, as well as residues from the agro-industry, that should be treated to all effects as by-products, i.e. excellent resources to be valorised

in a simplified way compared to waste. Therefore, it is strategic to contain the flow of such materials that, due to the lack of a clear regulation on this matter, are being reduced to the rank of waste. As a paradox, rivers of resources are flowing into a sea of landfills – anachronistic and impacting structures – that we should be able to reduce up to their total elimination (target set by the Landfill Directive 1999/31/EC).

2. Regulative aspects.

2.1. Existing EU regulations with respect to digestate and compost

The Communitarian framework regulation is Directive No 2008/98/EC of 19 November 2008, that sets the regulatory framework concerning waste management in the EU. This Directive defines some basic concepts, such as the definitions of waste, recycling and recovery and lays down some basic waste management principles. The Directive also specifies which "substances and objects resulting from a production process, not primarily aimed at producing, are considered by-products and not waste", on the basis of certain requirements included in Art. 5, reported here below.

- *By products*

A substance or object, resulting from a production process, the primary aim of which is not the production of that item, may be regarded as not being waste referred to in point (1) of Article 3 but as being a by-product only if the following conditions are met:

(a) further use of the substance or object is certain;

(b) the substance or object can be used directly without any further processing other than normal industrial practice;

(c) the substance or object is produced as an integral part of a production process; and

(d) further use is lawful, i.e. the substance or object fulfils all relevant product, environmental and health protection requirements for the specific use and will not lead to overall adverse environmental or human health impact.

On the basis of the conditions laid down in paragraph 2 of article 5, Member States may adopt the relevant measures to improve the criteria necessary to evaluate if a substance or object shall be regarded as being a by-product and not as a waste. This opportunity is extremely important in order to solve some interpretative problems of the mandatory criteria. Ministries for the Environment, Land and Sea is working in this direction, as will be described in the following paragraphs.

The first drafts of the Directive on waste did not define the category of by-product, which was introduced only later in the Communitarian Regulation by the European Court in 2008, at the end

of a process started in 2002 (European Court of Justice – Third Section – 18 December 2007, Case C-263/5).

However, in 2007, a year before the approval of the Directive on waste, the requirements were already partially found in Communitarian Legislation and partially transposed into national laws. According to the European Court (18 April 2002), by-product could be "subtracted" from waste regulation if it had been: "an undesired residue of production, reusable without changes during the production cycle".

For the improvement of by-product definition, a milestone was the judgement by the European Court of Justice of 18 December 2007 (C-263/5), which established that: *"in certain situations, goods, materials or raw materials resulting from an extraction or manufacturing process, which is not primarily intended to produce that item may be regarded not as a residue but as a by-product, which the holder does not seek to "discard" in accordance with art. 1, letter a) of the directive, but that it intends to exploit or market – possibly also for the need of economic operators other than the manufacturer – provided the condition that its reuse is certain, without prior processing and intervenes in the course of the process of production or use".*

In addition to the criterion of whether or not a substance constitutes a production residue, a second relevant criterion for determining whether or not that substance is waste for the purposes of Directive 75/442 is, therefore, the degree of likelihood that that substance will be reused without any prior processing. If, in addition to the mere possibility of reusing the substance, there is also a financial advantage for the holder in so doing, the likelihood of such reuse is high. In such circumstances, the substance in question must no longer be regarded as a burden which its holder seeks to 'discard', but as a genuine product (see judgments Palin Granit, paragraph 37 and Niselli, paragraph 46).

In most cases, potentially long-term storage operations constitute a burden to the holder and are also potentially the cause of precisely the environmental pollution which Directive 75/442 seeks to reduce. The reuse is therefore not certain and is only foreseeable in the longer term, with the result that the substance in question can only be regarded as extraction residue which its holder 'intends or is required to discard' (judgments Palin Granit, paragraph 38 and Avesta Polarit Chrome, paragraph 39).

In conclusion, *goods, materials or raw materials resulting from a manufacturing process which is not designed to produce them may be regarded as by-products which the holder does not seek to discard, only if the reuse of the item, included the one for the need of economic operators other than the manufacturer, is not merely a probability but a certainty, does not require any prior processing and intervenes during the process of production and use.*

2.2. The course of implementation

The residues of the agricultural and agro-industrial production play a key role in the new European economic strategy linked to Bioeconomy.

As mentioned in the introduction, on December 2, 2015 the European Commission adopted a new package of measures to promote the transition of Europe towards a circular economy that, according to the Commission, would increase global competitiveness, support economic growth and generate new jobs.

The new package of measures includes some reviewed legislative proposals concerning waste, landfills and packaging. The proposals on waste have a clear and ambitious vision over the long-term, aims at increasing recycling and reducing landfilling, while proposing a string of tangible measures to break down barriers to the improvement of waste management, with regard to the respective circumstances of Member States.

The package changes some directives already in force for years (Waste, Landfills and Packaging), while including only communications concerning other issues (WEEE and End of Life Vehicles), and only a simple report about the Batteries and Accumulators Directive.

1. *Framework Directive 2008/98/EC as amended by the new Directive on the basis of a new proposal on December 2, 2015*
2. *Landfills Directive 1999/31/EC as amended by the new Directive proposed on December 2, 2015*
3. *WEEE Directive 2012/19/EU as amended by the new Directive proposed on December 2, 2015*
4. *End of Life Vehicles Directive 2000/53/EC as amended by the new Directive proposed on December 2, 2015*
5. *Packaging Directive 94/62/EC as amended by the new Directive proposed on December 2, 2015*
6. Batteries and Accumulators Directive 2006/66/EC *as amended by the new Directive proposed on December 2, 2015*

According to the Commission, *"the transition to a more circular economy, in which the value of products, materials and resources is kept as long as possible and the production of waste is minimised is an indispensable component of the efforts put in place by the European Union to develop an economy that is sustainable, releases few emissions of carbon dioxide, uses resources efficiently and remains competitive".*

Therefore, according to this proposal *"it is important to promote the innovation of industrial processes, as the industrial synergy, thanks to which wastes and by-products of a factory become raw material for another one. The Commission, in its proposals for the revision of waste legislation,*

presents some elements aiming at facilitating this practice and intends to launch a dialogue with Member States to ensure a common interpretation of the laws on by-products".

According to the Commission, the Proposal of Amendment of the Waste Directive should, among other things, aim at clarifying the regulations on by-products, in order to promote their optimal use. Unfortunately, the amendment of article 5 does not enter into the merits of the mandatory requirements, some of which represent an enigmatic issue and remodels the authority of Member States that will no longer be allowed to *adopt measures in order to establish criteria to be met, so that a substance or object is regarded as being a by-product and not as waste*. As a consequence, the Commission becomes the only responsible for all the relevant measures on the issue and limits the self-determination of Member States with the purpose of promoting uniformity of interpretation. Here follows the Proposal of Amendment of the article on by-products.

By-products

1. Member States ensure that a substance or object resulting from a production process, the primary aim of which is not the production of that item, may be regarded as not being waste, but as being a by-product only if the following conditions are met:

   (a) further use of substance or object is certain;

   (b) the substance or object can be used directly without any further processing other than normal industrial practice;

   (c) the substance or object is produced as an integral part of a production process; and

   (d) further use is lawful, i.e. the substance or object fulfils all relevant product, environmental and health protection requirements for the specific use and will not lead to overall adverse environmental or human health impacts.

2. The Commission shall set detailed rules in accordance with article 38a with the aim of establishing the implementation criteria as of paragraph 1 for specific substances and objects.

3. Member States shall communicate to the Commission the technical rules adopted in compliance with paragraph 1 of Directive No 2015/1535/EC of the Parliament and the European Council as per Directive requirement.

Digestate

At European level, digestate, although often regarded as a waste, may be used in agriculture provided that some quality conditions are being met. In any case, the use of digestate for agriculture is normally permitted by national regulations, even in certified organic cultivations.

In Italy the issue is much more complicated, due to the fact that both legislation and jurisprudence emanated ambiguous measures, according to which digestate may alternatively be included in the categories of by-product or waste.

3. Legislative framework analysis for digestate and compost.

The first European regulation of reference that treated the issue of digestate was the 1991 Waste Directive, in the broader field of interest related to surface water and groundwater protection from pathogens that, over a certain threshold, compromise the quality of water. Since then, European authorities have approved other laws.

According to the Framework Directive on Waste (2008/98/EC), Member States shall take the necessary measures *"to ensure that waste management is carried out without endangering human health and harming the environment, able to ensure a sustainable use of natural resources".* The initiatives outlined are designed to promote best possible use of existing legislation, leaving Member States a wide margin of discretion in choosing the avenues of action that are best suited for their respective circumstances. In any case, for all members the univocal point of reference is given by the "waste hierarchy" through which are established the principles of prevention followed by reuse and recycling, to end up with energy recovery.

As already mentioned, digestate, regarded by many Member States as being a waste, is the subject of a new strategy of use, that takes into account all relevant requirements of health and environment protection.

In 2010 the European Commission, with the Communication COM 235 (2010) *"on future steps in bio-waste management in the European Union"*, highlighted the excessive production of waste due in particular to common practices and inadequate waste management systems. This situation, that has a high impact on economy and environment, must be solved quickly and efficiently. In relation to the issue of organic waste, the Commission established that *"compost and digestate"* obtained from bio-waste are under-used materials. This happens because *"Member States demand suffers from a lack of end-user confidence"*. To address this issue, the use of these materials should be regulated in such a way that no adverse effects are generated on soil. This problem might be solved by proper regulations that allow the free circulation in market of these materials, their use without further monitoring and control of soils on which they are spread. From 2014, thanks to the Implementing Regulation (n. 354/2014 of 8 April 2014), has been recognised the possibility of using digestate from biogas resulting from the treatment of by-products of animal origin mixed with materials of plant origin and, upon authorization in accordance with Legislative Decree No 75/2010, of placing it on the market as a fertiliser. In wait for the approval of the Regulation on fertilisers from organic waste (proposed on 17 March 2016), digestate might be regarded as a marketable

organic fertiliser. At the present time there is not a univocal regulation on digestate in EU Member States. In the absence of bilateral agreements among States, some products are not allowed to cross borders. The target of the Regulation on organic fertilisers, within the package of measures on circular economy, also consists of facilitating EU market access to fertilisers from organic waste, creating equal conditions for concurrence between organic and chemical fertilisers. Here follows the summary of the aforementioned regulations up to May 2016.

3.1. EU Directive 91/676/EC

Known as the Nitrates Directive, it is the first Regulation that has addressed the issue of digestate at European level. The Directive, approved in 1991, was intended to protecting water quality, preventing pollution of surface waters and groundwaters caused by chemical compounds (in particular nitrates) released in soil by agricultural activities, and to encouraging good agricultural practices. The law, in setting standard criteria for water protection, compares digestate to livestock effluents.

After the transposition of the law, all Member States and delegates (the Regions in Italy), set up the "Action Programmes for Nitrate Vulnerable Zones". In the 27 EU Member States the 39.6% of territory is subjected to the implementation of over 300 action programmes. The measures provided by the Directive define all requirements for the spreading of fertilisers, the rules on capacity and construction of storage vessels for livestock manures and the conditions for land application of fertilisers near water courses. To summarize, this Directive provides:

1. Nitrate Vulnerable Zones (NVZ) where is prohibeted the spreading of livestock effluents (and waste from small businesses of the agro-food sector) over 170 kg of nitrate of animal origin per hectare and per year. Rules about the agronomic use of livestock effluents form farms and industry, through the adoption of specific Action Programmes;

2. Equalisation between digestate – as an input material of the biogas plant – and livestock manure

This Directive was transposed at national level in all Member States. This happened in Italy with the first Legislative Decree No 152 of 11 May 1999 and the subsequent Legislative Decree No 152 of 3 April 2006 (of the Environment Code)3, at the present moment replaced and updated by the recent Interministerial Decree No 5046 of 25 February 2016 entitled "Criteria and general technical standards for the regional regulation on the agronomic use of livestock effluents and wastewaters pursuant art. 113 of Legislative Decree No 152 of 3 April 2006, as well as digestate production and agronomic use pursuant art. 52, para 2-bis of the Decree Law No 83 of aa June 2012, converted into law No 134 of 7 August 2012".

Limits of heavy metals and pathogens in digestate

Many Member States lack a proper legislation concerning limit values of heavy metals and control of pathogens in digestate. The European law, that mostly addresses this concern is Directive 86/278/EC of 12 June 1986, concerning protection of the environment and in particular of soil, from the use of sewage sludge in agriculture (OJ L 181 of 4 July 1986). The Directive has the purpose of preventing harmful effects on soil, vegetation, animals and man and encouraging the correct use of sewage sludge. The restrictions on the use of sewage sludge are currently limited to seven heavy metals: cadmium, copper, nickel, lead, zinc, mercury and chromium. At the same time, in order to prevent the spread of pathogens in the environment and the subsequent contamination of animals and plants, the Directive establishes periods, during which land application of sewage sludge is prohibited, as well as plants on which it may be applied.

With regard to the Legislation on control of pathogens in relation to the use of digestate as a fertiliser, the first Member State to have legislated in this sense has been Denmark, then followed by other countries.

In countries such as Germany, Austria and Sweden, where the legislation is relatively new, the experience of Denmark has been an example to follow in order to establish proper regulations.

3.2. Green Papers: Management of biodegradable organic waste in the EU – COM 811 of 3 December 2008

Green Papers are documents published by the European Commission to stimulate discussion on given topics at European level. They invite the relevant parties (bodies or individuals) to participate in a consultation process and debate on the basis of the proposals they put forward. Green Papers may give rise to legislative developments that are then outlined in *White Papers*, even if this target has not been achieved yet concerning biodegradable waste. At the present moment, the reference document in matter of waste still remains Directive 98/2008, while the reference for an only partial classification of organic waste is the 2010 Communication from the Commission to the Council and the European Parliament.

In the Green Paper, **digestate** is still regarded as being a "waste", as it was taken into account only the one resulting from the treatement of materials from differentiated waste collection. At page 3 is stated that *"among the available options for organic waste management are, in addition to prevention, waste collection (whether differentiated or not), anaerobic digestion and composting, incineration and landfilling. Economical and environmental benefits of the different treatments remarkably depend on local conditions, such as population density, infrastructures and climate, as well as markets and related products (energy and compost)".*

Digestate is also regarded as being a waste, in fact: *"the residue of a process, called digestate, may undergo composting treatment and be used for similar purposes as compost, with the consequence of improving the overall recovery of resources from waste".*

3.3. Communication from the Commission to the Council and the European Parliament – COM 235 (2010)

This Communication concerns further measures in matter of organic waste disposal in the EU, is open to a wider possibility of use of digestate and clarifies that:

a) optimization of recycling operations and organic waste recovery would bring to a series of benefits and synergies. For instance, if in soil is spread digestate resulting from biogas plants, anaerobic digestion might contribute to the achievement of target for reduced CO2 emissions both through the development of bioenergy and biofuels, as well as good practices for soil organic carbon stock and soil fertility.

b) *"Standards for compost and digestate should be established to enable their free circulation on the internal market and to allow using them without further monitoring and control of the soils on which they are used. The procedure defining when a material ceases to be a waste, provided by the regulatory framework in matter of waste, might be the most efficient way to define these rules. The Commission shall soon give start to the works intended for evaluating the technical requirements for a possible proposal. It is not difficult to assume that not all organic wastes which undergo an organic treatment meet the standards of "product", even if those items, when properly used, could give a precious contribution to carbon-poor lands. An entire harmonisation among EU Member States would not be possible due to the respective circumstances (such as quality and soil requirements). However, minimum standards should be adopted at European level, in oder to create a "security network" against any harmful use".*

c) *Research and Innovation may result in new technologies and practices for organic wastes (advanced applications in matter of fertilisation and bioenergy, applications of biochemicals and biomaterials). The seventh EU regulatory framework for the technological research and development (2007 – 2013) practically contributes to this type of development. Several parts of EU cooperation programmes promote activities in support of organic waste prevention and/or economic values optimization.*

3.4. Commission Implementing Regulation (EU) No 354/2014 of 8 April 2014 amending and correcting Regulation EC No 889/2008 laying down detailed rules for the implementation of Council Regulation (EC) No 834/2007 on organic production and labelling

of organic products with regard to organic production, labelling and control.

In the Premises of the Regulation is stated that: *"Based on the recommendations of the EGTOP4, which concluded as regards fertilisers and soil conditioners that the substances biogas digestate, hydrolysed proteins from animal by-product origin, leonardite, chitin and sapropel comply with the organic objectives and principles, those substances should be included in Annex I to Regulation (EC) No 889/2008 for use under certain specific conditions"*. In particular, with this regulation is amended Annex I of the previous Regulation with the list of fertilisers that are usable in organic production, in case the basic rules (crops rotation, green manure, organic fertilisation activities and other activities) are not sufficient for meeting crops nutritional requirements. This list has been integrated with "*digestate resulting from biogas containing by-products of animal origin with materials of plant or animal origin".* In this way, was approved the use in organic agriculture of digestate to which shall be applied the same rules of livestock effluents.

3.5. Circular Economy Package – Legislative Proposal of the Council and the European Parliament establishing rules related to the placing on market of fertilising products with CE Marking and modifying EU Regulations No. 1069/2009 and No 110/2009/EC – COM 157 (2016).

The main strategic purpose of the initiative, already mentioned and anticipated by this section, consists in encouraging EU large-scale production of fertilisers obtained from national raw materials, organic or secondary, compliant with the model of circular economy, through the processing of wastes in nutrients for crops, after the analysis of the current Regulation.

This Proposal of Regulation is an essential tool to solve some critical circumstances due to a difference in regulations of Member States which have not been harmonised yet, with a consequent problem in the circulation of goods. It will be possible to overcome this situation, only if Member States shall achieve a memorandum of understanding. In fact, according to premises *"First, innovative fertilising products, often containing nutrients or organic matter recycled from biowaste or other secondary raw materials in line with the circular economy model, have difficulties accessing the internal market due to the existence of diverging national rules and standards".*

Around 50% of the fertilisers currently on the market, however, are left out of the scope of the Regulation No 2003/2003 (EC). Incidentally, the current regulation on fertilisers concerns almost exclusively those fertilisers produced from inorganic materials resulting from mining or synthetically. From the Regulation are excluded some inorganic fertilisers and almost all fertilisers produced from inorganic sources, as by-products of animal or agricultural origin, or those resulting from recycling of organic waste from food chain. This aspect, colliding with the recent perspectives

of circular economy, is due to the fact that the Regulation was conceived at the time for inorganic fertilisers having specific characteristics and resulting from raw materials. Today, scientific reasearch and large investments in innovation activities, led to the production of the so-called "*Innovative Fertilisers*" obtained from organic or seconday raw materials. The use of these fertilisers if, on the one hand represents a great opportunity in a sustainable development, on the other hand prefigures a challenge due to the strict control that should be provided to ensure a proper use of raw materials.

This Proposal is intended to govern the sector of fertilisers, extending the scope to innovative fertilisers with high environmental requirements, improving approval procedures (type approval procedure is still lengthy) and harmonising new and traditional fertilisers.

To summarize, this initiative, according to the European Commission, *"will boost investment and innovation in the circular economy (…) and will create a level playing field for all fertilising products and facilitate recourse to domestic, secondary raw materials. (…) Furthermore, the initiative supports the aim to create a deeper and fairer internal market with a strengthened industrial base, by removing existing barriers to free movement of certain innovative fertilisers and facilitating the market surveillance by Member States.*

The approach of this report to the aforementioned Proposal is due to the fact that the new Regulation will also involve both private and public stakeholders (such as operators of plants for wastewater treatement or waste management plants that produce compost or digestate), who will be able to promote their products and thus facilitate investments in their facilities.

Here follows the definition of fertiliser according to the new Proposal that, when approved, might solve the many litigations taking place in our country. In fact, this definition may also include digestate, that at certain conditions shall be marketed as a fertiliser on domestic market.

Article 2 Definitions – para 1. *"Fertilising product": a substance, a mixture, a microorganism or any other material, applied or intended for application, alone or in combination with other materials, to the plants or their rhizosphere, with the purpose of providing nutrients for plants and improving nutritional efficiency".*

3.6. European Commission Joint Research Institute for Prospective Technological Studies, JRC – Report EUR 26425 EN 2014 Hans Saveyn & Peter Eder End-of-Waste criteria for biodegradable waste subjected to biological treatment (compost & digestate): Technical Proposals.

The management of digestate is finally being treated at European level with an important document published by JRC (Joint Research Centre). In this document, after a long time, it is recognized also at

European level that: *"(…) In some circumstances, biogas yields may be relatively low but the process of anaerobic digestion offers other advantages. This is especially true for manure. Apart from lower greenhouse gas emissions, other increasingly environmental advantages are linked to the use of digestate as a bio-fertiliser instead of the untreated manure, with a consequent reduction of odour emissions, increased animal health safety, reduction of pathogens and weed seeds (Lukehurst et al., 2010).*

From the process of anaerobic digestion is obtained a digestate that may be applied to field surfaces as an organic liquid fertiliser. In some plants, digestate is divided into solid and semisolid shovelable fraction.

As an alternative, digestate may undergo the aerobic composting. The liquid is being recycled to a large extent in the composting process and the part exceeding is used as a fertilising liquid, if quality is good. Anaerobic digestion is performed using biodegradable fractions from urban waste collection, agricultural waste (manure, wastes, straw, beet and potato leaves), wastes of food industry (residues of beer production, grape crushing, sugar production, slaughtering, by-products and residues resulting from meat processing and wastewaters from milk processing) and sewage sludge".

It is, therefore, explicitly recognized the important role of digestate. In Annex 1 is given an overview of biodegradable waste management in 25 EU State Members, as reported here below:

Table 3.1: Management of biodegradable waste in EU Member states

Table 3.1: Management of biodegradable waste in EU Member states

	Bio and green waste composting	Anaerobic digestion	Mixed municipal solid waste composting	Other mechan. biological treatment	Landfilling	Incineration
Country	B/GWC	AD	MSWC	MBT	LAND	INCIN
AT	X	X	-	X	-	X
BE	X	-	-	-	-	X
CY	-	-	-	-	X	-
CZ	X	-	-	-	X	X
DE	X	X	-	X	-	X
DK	X	-	-	-	-	X
EE	X	-	-	-	-	-
ES	X	X	X	-	X	X
FI	X	X	-	X	X	-
FR	X	-	X	X	X	X
GR	-	-	-	X	X	-
HU	X	-	-	X	X	-
IE	X	X	-	X	X	-
IT	X	-	-	X	-	X
LT	X	X	-	X	X	-
LU	X	X	-	-	X	-
LV	X	-	-	-	X	X
MT	-	-	-	-	X	-
NL	X	-	-	-	-	X
PL	X	-	X	X	X	-
PT	X	X	X	X	X	X
SE	X	X	-	-	-	X
SI	X	X	-	-	X	-
SK	X	-	-	-	X	-
UK	X	X	-	-	X	-

3.6.1.1 Legislative aspects for digestate use in some Member States

As highlighted by JRC report but also by research studies carried out by other European work groups, such as that of Åke Nordberg on which this paragraph is concerned, the regulatory framework is extremely heterogeneous at European level, without any harmonisation between Member States.

Each country has its own criteria of digestate use, based on the origin of input materials (waste and agricultural residues) with different rules and parameters concerning the content of nutrients, heavy metals, dry matter, admissible extraneous materials, pH indicator and pathogens such as Salmonella and coliforms.

Germany

Digestate is mainly used as a fertiliser, without any prior treatment; only 10% of the plants of waste digestion use the process of composting. The 6% of digestate has a "seal of quality", that is mandatory for compost (BGK – Bundesgütegemeinshaft Kompost), products from digestate and composting of sewage sludge. The Federal Kompost (BGK) is a professional association located in Cologne, the statutory purpose of which is the monitoring of compliance with quality standards for organic waste treatment from households, gardens and parks. It is an independent organization that follows only the criteria set by the Institute of Quality and Control, RAL Deutsche. The BGK association distinguishes several types of quality standards:

(a) **Compost products** (RAL-GZ 251)**: fresh compost, manure compost, compost for potting soil**

(b) **Digestate products from biowaste** (RAL-GZ 245)**: solid and liquid digestates**

(c) **Digestate products from renewable energy crops** (RAL-GZ 246)**: solid and liquid digestates**

(d) **Composted sludge products** (RAL-GZ 258)**: sludge-based mature compost, sludge-based fresh compost**

Netherlands

Digestate obtained from anaerobic fermentation of substrates from municipal waste collection undergoes an aerobic post-treatment (composting) and the result is marketed as a fertiliser or substrate. Digestate resulting from undifferentiated waste collection does not achieve a good quality for agriculture, not even after composting, so is incinerated and sometimes sent to landfills, even if this alternative is strongly discouraged by authorities.

Sweden

The 97% of digestate resulting from plants using waste anaerobic treatment (from municipal waste collection, sewage sludge or their mixture) is used in agriculture, without any specific treatement. Only 20% of the plants separate solid and liquid fractions and only 2% carries out the composting of solid fraction. Digestate, regardless of the type of input material, can be used in agriculture only if subjected to quality standards control according to Spcr 120 rules – (Certification rules for digestate from biowaste by the quality assurance system of Swedish waste management). Digestate of lower quality, non-compliant with best quality parameters, may be used in floriculture, golf courses, non-food crops. Poor quality digestate has a limited field of application and when it contains too many pollutants is dried and sent to incinerators.

Belgium

Only farms are authorized to use the liquid fraction of digestate, while its private use is not permitted. The reason is due to Belgian legislation, which considers digestate as not sufficiently stable to allow its packaging and retail distribution and requires to professional users a specific equipment for soil application of the liquid fraction. In Belgium, digestate, in order to be considered as stable and dry, shall contain a percentage of dry matter equal or over 80%: from that, it is obtainable an easy to use granular product. The final product is called “partially dried fertiliser”. In the future, Belgian authorities might give the relevant authorizations for the use of these products to private consumers under strict conditions, as the compliance with specific input materials, process control and quality standards of final product.

Slovenia

At the time of JRS report (2014) there were 11 anaerobic digestion plants, of which only seven fed with agricultural biomass. Digestate is used in agricultural soils, with restrictions on nitrogen compounds in accordance with the national transposition of the Nitrates Directive (OJ of the Republic of Slovenia No 113/09).

England

According to the UK Organics Recycling Group, all types of digestate may be used as fertilisers, soil improvers and, in case of low content of dry matter, as foliar fertilisers. Liquid fraction may be used as biofertiliser, while solid fraction can be used as biofertiliser, organic soil amendment and manure. The UK has developed an AD Quality Protocol defining the status of “end-of-waste product” for digestate, i.e. those wastes that undergo a process of anaerobic digestion and are turned into digestate. Quality standards are included in British standard Bs-Pas 110.

Regulations and rules for the use of compost vary remarkably from country to country. For some of them, the use of compost is subjected to a complex series of national and regional regulations (Germany, Netherlands and Austria), while for others, compost may be used without any law prescription (Greece, Portugal, Slovenia). It is worth to mention that the main restrictions usually regard: quantity of compost (tons of dry matter), maximum levels of heavy metals (quality compost) that may be spread within a period of 2-5 years. The chart gives an overview of the current restrictions.

Application rules to be followed:

a) limitation of direct load (grams of substance per hectare and per year), in most cases assessed within a period of 2-10 years;

b) dose restrictions on admissible dry matter in compost per hectare per year;

c) limits of mineral nutrients (phosphorus and/or nitrogen) to farmland.

The following chart summarizes the regulation concerning the use of compost in the EU.

	Regulation	Requirements or restriction for the use of compost
AT	Compost Ordinance	▯ Agriculture: 8 t d.m. /ha*y on a 5 year basis ▯ Land reclamation: 400 or 200 t d.m. /ha*y within 10 years depending on quality class ▯ Non food regular application: 20 or 40 t d.m. /ha*y within 3 years dep. on quality class ▯ El. Conductivity > 3 mS/cm: excluded from marketing in bags and for private gardening
	Water Act	▯ Specific application requirements pursuant to the Action Programme following the EU Nitrate Directive (e.g. limitation to 210 or 170 kg total N per hectare an year)
BE *Flanders*	Royal decree for fertilisers, soil improvers and substrates Fertiliser Regulation (nitrate directive) VLAREA waste regulation	▯ An accompanying document with user information is obligatory. ▯ Fertiliser Regulation limits N and P, partly more compost use possible because of beneficial soil effects compared to manure. ▯ VLAREA require VLACO Certificate for use and limits max. level of pollutants and show conditions for max application rates ▯ Not specifically for organic waste, so all the conditions are laid down in the certificate of use
Wallonia	Arrêté du Gouvernement wallon favorisant la valorisation de certains déchets	
BG	No data available	n.d.
CY	No data available	n.d.
CZ	Bio-waste Ordinance, Waste Act (2008)	▯ According to the coming Bio-waste Ordinance (2008) for the first class there are restrictions according to Ordinance on hygienic requirements for sport areas, the 2nd best can be used with 200 t d.m/ha. in 10 years.
	Fertiliser law	▯ Fertiliser law requires application according to good practice.

DE	Bio-waste Ordinance (BioAbfV 1998) Soil Protection Ordinance (BbodSchV 1999) Fertiliser Ordinance (DÜMV, 2003)	▯ The Bio-waste Ordinance regulates agricultural use with compost Class I 20 t d.m. in 3 years, Class II 30 t d.m. in 3 years. ▯ Soil Protection Ordinance for non agricultural areas between 10 and 65 t d.m. compost depending on use. ▯ Fertilising with compost according to good practice
DK	Stat. Order 1650 0f 13.12.06 of the use of waste (and sludge) in agriculture	▯ 7 t d.m. /ha*y on a 10 year basis ▯ Restriction of nitrogen to 170 kg /ha*y ▯ Restriction of phosphorus to 30 kg /ha*y average over 3 years ▯ The levels for heavy metals and organic compounds are restricted in the INPUT material for the composting process
EE	No compost restrictions	Only restrictions for the use of stabilized sludge "sludge compost"
ES	Real Decree 506/2013 on Fertiliser Products	▯ Class C compost (mixed waste compost) 5t d.m./ha*y
FI	Decree of the Ministry of Agriculture and Forestry on Fertiliser Products 12/07	▯ Maximum Cd load/ha 6 g during 4 years (crop growing area), 15 g during 10 years (landscape gardening), 60 g during 40 years (forestry); ▯ Soluble phosphorus load per 5 years 400 kg (farming), 600 (horticulture) and 750 (landscape gardening); soluble nitrogen load during 5 years in landscape gardening max. 1250 kg.
FR	Organic soil improvers - Organic amendments and supports of culture NF U44-051	From the moment a compost meets the standard NF U44-051 there is no rule for the use. In the standard, flows in heavy metals, and elements are restricted to the maximum loading limits: ▯ Per year g/ha: As 270, Cd 45, Cr 1,800, Cu 3,000, Hg 30, Ni 900, Pb 2,700, Se 180, Zn 6,000 ▯ Over 10 years g/ha: As 900, Cd 150, Cr 6,000, Cu 10,000, Hg 100, Ni 3,000, Pb 9,000, Se 600, Zn 30,000
		▯ Application should follow good agrarian practices, and agronomical needs which are taken into account for the use of composts.
GR	Common National Ministerial Decision 114218/1997 Hellenic Ministerial Decision	Upper limits for amounts of heavy metals disposed of annually in agricultural land Cd 0,15, Cu 12, Ni 3, Pb 15, Zn 30, Cr 5, Hg 0,1, kg/ha/y

HU	49/2001 Statuory Rule about the protection of the waters and groundwaters being affected by agricultural activities 10/2000. (VI. 2.) KöM- EüM-FVM-KHVM - Water protection rule	□ Compost application on agricultural land is limited by the amount of nutrient with 170 kg/ha Nitrogen. □ Dosage levels depending on background contamination and nutrient content level in the soil laid down in the National Statutory Rule about the threshold values for the protection of the ground- and subsurface waters and soils.
IE	Statutory Instruments SI No. 378/2006 Good agricultural practice for protection of waters: Statutory instrument 253 of 2008	□ IE Nitrate regulation: Compost has to be included in the Nutrient Management Plan. Availabilty of nutrients calculated like cattle manure. □ There are specific waiting periods to consider for animal access to land fertilised with bio-waste compost based on the Animal-By-Product Regulations. o Catering waste: 21 d for ruminant animals; 60 d for pigs; o Former foodstuff & fish waste compost: 3 years (under revision)
IT	National law on fertilisers L. 748/84 (revised in 2006 with the new law on fertilisers, D.lgs. 217/06) Regional provisions	□ Compost has to be considered a product to be used according only to Good Agricultural Practice as long as it meets the standards. No restriction is set on loads for unit area □ Some regions have codified approaches for low grade materials applications and landfill reclamation, building on the old regulation on "mixed MSW compost" (DCI 27/7/84)
LT	Environmental Requirements for Composting of bio-waste, approved by the Ministry of the Environment on 25 January 2007, No. D1-57 Standards for sewage sludge use for fertilising and redevelopment LAND 20-2005 (Gaz., 2005, No. 142-5135)	□ When compost used for improve the quality of the soil, the annual quantity of the heavy metals can not exceed norms according LAND 20-2005. □ Compost application in agriculture and or soil reclamation purposes, is restricted by contamination with pathogenic microorganisms, organic micropollutants and heavy metals (according to LAND 20-2005) □ Compost application on agricultural land is limited by the amount of nutrient with 170 kg/ha Nitrogen and 40 kg/ha Phosphorous per year
LU	EU Nitrate Directive	□ No specific regulations; advise (voluntary): 15 t d.m. /ha *y □ Only record keeping about the compost use and send to the Ministry
LV	No regulations	only for sewage sludge compost
MT	No data available	

NL	Fertiliser Act (2008)	☐ Compost has to meet the national standard (heavy metals) ☐ In the new fertiliser legislation limitations for application are only based on the nutrient content for agriculture, so called standard values of max. 80 kg P_2O_5 /ha*y, 100 kg N /ha*y, 150 K_2O /ha*y, 400 kg neutralizing value /ha*y or 3000 kg organic matter /ha*y ☐ For some crops which grow in the soil (e.g. potatoes) compost needs certification and a low glass content < 0.2 %
PL	The Act of 10 July 2007 on fertilisers and fertilisation (Journals of Laws No. 147, item 1033, as amended)	☐ Organic fertilisers and plant conditioners containing compost can be marketed and used on the Polish territory on the basis of a license from the Agricultural Ministry; ☐ Products containing compost are used exactly as given in the instructions for using and storing the product, which is an integral part of the license; ☐ A limit for nitrogen use of 170 kg of nitrogen (N) in the pure ingredient per ha and per year only applies to natural fertilizers
PT	No regulations available	---
RO	No data available	n.d.
SE	The Swedish Board of Agriculture: SJV 1998:915 (sewage sludge regulation)	☐ Fixed maximum heavy metal load Maximum heavy metal load (g/ha*y): Pb 25; Cd 0.75; Cu 300; Cr 40; Hg 1.5; Ni 25; Zn 600
	Nitrate directive	Agriculture: nitrogen: 150 kg/ha*y and phosphorus: 22 – 35 kg/ha*y
SI	Decree on the treatment of biodegradable waste (Official Gazette of the Republic of Slovenia, no. 62/08)	☐ Class I can be used without any restrictions. ☐ Class II can be spread with a special permission with a limited application rate considering the heavy metal content and load after an evaluation and risk assessment performed by a lab (but not more than 10 t d.m./ha /year).
	Decree concerning the protection of waters against pollution caused by nitrates from agricultural sources (Official Gazette of the Republic of Slovenia, no. 113/09)	☐ Application of organic fertilizer on agricultural land is limited by the amount of nutrient with 250 kg/ha Nitrogen.
SK	Act No. 220/2004 Col. on protection and using of agricultural soils	☐ Lays down limit concentrations of risk elements in agricultural soils

	Ministry of Agriculture Decree No. 26/2000, on fertilisers.	▯ Lays down fertiliser types, max. concentration of risk elements in organic fertilisers, substrates and commercial fertilisers, storage and take-off conditions, and methods of fertiliser testing
UK	Each country of the UK has different requirements Here is an example of parts of the regulations applicable for England and Wales	▯ Use in agriculture and applications to soil other than land restoration: A Waste Management Licence Exemption, Paragraph 7A, must be obtained by the land owner/manager before accepting and storing then spreading compost. The compost must be made from source segregated bio-waste. Per Paragraph 7A exemption: ▯ 'Benefit to agriculture' or 'ecological improvement' must be demonstrated, which is done by spreading compost as per Nitrate Vulnerable Zone regulations if within a NVZ, and following the Codes of Good Agricultural Practice for the Protection of Soils and Water. Given the typical total nitrogen content of ‚Green compost', the application rate would be approximately; ▯ 30 - 35 fresh tonnes per hectare per year where a field NVZ limit of 250 kg total nitrogen per hectare applies, ▯ 30 fresh tonnes per hectare per year if ‚Not NVZ' but as per good agricultural practice, or ▯ 60 – 70 fresh tonnes per hectare once per two years if ‚Not NVZ' but as per good agricultural practice. ▯ If the compost is classed as a waste, the Environmental Permitting Regulations apply (paragraph 7 exemption, U10 exemption or Standard Rules Permit) and a permit or exemption will be required by the land owner/manager before storing or spreading the compost. If the compost has ceased to be waste ▯ Voluntary Code of Good Agricultural Practice for the Protection: limitation of nitrogen of 250 kg /ha/y (for all types of 'organic manure' used, including composts); compost can also be applied at a rate of 500 kg/ha once per two years

4. State of the art for quality assurance of compost and anaerobic digestion.

4.1. Quality of bio-waste

One of the goals of biowaste collection (mainly food-waste) is the reduction of the amount of non-compostable materials (contamination) for maximizing the recovery through composting and/or anaerobic digestion (AD). Initially, a high citizens participation rates was facilitated providing users with kitchen caddies and plastic bags. However, over the years, this practice has evolved, switching to compostable bags, which have brought a reduction of contamination, and vented caddies that allow the material to “breathe” and thus reduce odors and molds.

The Compost quality is based on feedstock composition and purity. Hence waste-audits are conducted at the producers' facilities, for monitoring the quality of organic waste collection. These analyses can be divided into three main groups:

Table 4.1: Types of biowaste audits

1	Composition of incoming food waste, so to determine the percentage of non-compostable materials not suitable for composting
2	Micro analysis which consist in product waste composition analysis of the contents of a single bag, for groups of bags of different types of material *(not described in the present document)*
3	Analysis on the type of bags used for the separate collection of biowaste, to distinguish the origin and type of material bags are made of

Audits to assess the quality of food-waste

4.2. Audits to assess the quality of food-waste

Only separately collected biowaste is allowed to be used as input material for the industrial composting and anaerobic digestion plants. Through visual controls at the gate and regular waste-audits of the biowaste, treatment plants ensure an input stream of continuous high quality.

The auditor assesses the percentage (w/w f.m.) of non-compostable fractions in the incoming waste; the Non-Compostable-Material quota (NCM) consists of different plastic items (i.e. bags, cups, etc.) and other non-compostable materials (i.e. glass, stones, metals, etc.). The quality of separately collected biowaste is classified according to five quality classes.

Waste-audits also allow to compare the effectiveness of bring schemes and curbside schemes in terms of keeping NCM sufficiently low to enhance recycling activities at composting and AD plants. Experience clearly shows how kerbside schemes significantly reduce the need for pre-sorting of delivered biowaste before waste recycling; hence kerbside collection also reduces significantly the amount of residues from the recycling process that need to be disposed of.

4.3. Production of quality compost

Compost is defined as a soil-amendment. Compost is divided into three categories, recognized as "End-of-Waste" according to the input feedstock:

- Green Compost (GWC): compost produced from green-waste only;
- Biowaste Compost (BWC): compost produced from biowaste, including both food- and green-waste;
- Sludge Compost (SWC): compost produced including also sludge inside the mixture of different feedstock.

The standards for End-of-Waste compost are set by the national Laws on Fertilizers and can be divided into agronomical parameters (pH, moisture content, Carbon and organic Nitrogen, etc...), environmental parameters (heavy metals, physical impurities) and sanitization parameters (Salmonella spp., E.coli).

4.3.1.1 Quality label for compost

Any quality label (QL) aims to assess the quality of compost produced by any kind of compost producer. The standards applied in the rules of a compost label are a useful instrument both for the producer of compost, as a way of monitoring the quality standards achieved, and for the consumer, who can verify the quality of the compost used.

Compost samples are taken by qualified operators, trained and authorized by respective authorized auditors and independent from the composting plants. Samples are analyzed by Laboratories accredited by the Ministries of Agriculture for analysis of soil improvers and growing media.

There is a continuously growing interest in quality Compost and a consequent significant increase of products labeled with the QLs. The reasons can be explained as follows:

- Substantial communication and marketing investments as well as public awareness activities and sharing of information;
- Convenient price of compost compared to the mineral fertilizers one;
- Incentives for compost use in organic depleted soils, including the use of Compost in Rural Development Plans so to restore organic matter content;
- Extensive availability of the product.

Quality Labels for compost are regulated by a Manuals and are configured as a Label for products. The Manuals describe the labelling process and requirements (scope, requirements of conformity, evaluations, procedures) for obtaining and granting the QL on compost quality. The instruments used to assess the quality of the compost produced are auditing, sampling, analyses and administrative controls.

After a pre-phase called “Application phase”, where the auditor provides to the plant-person-in-charge all the documents necessary to join the program, the flow chart of the QL is shown in the following schemes, divided into “Recognition phase” and “Monitoring phase”.

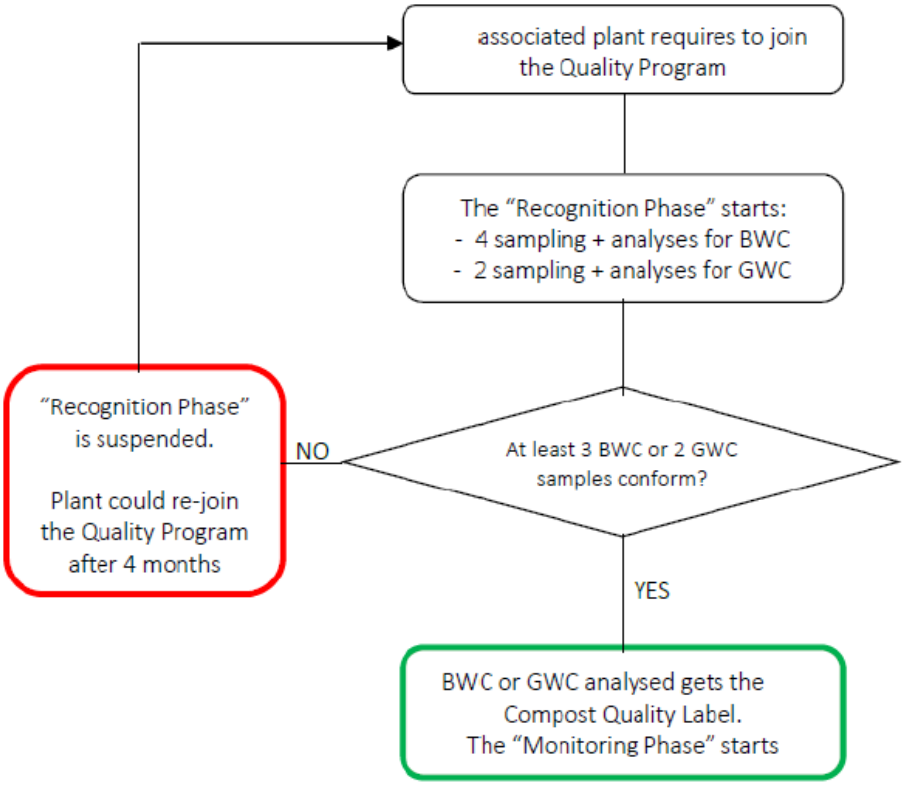


Figure 4.1. QL's Recognition phase

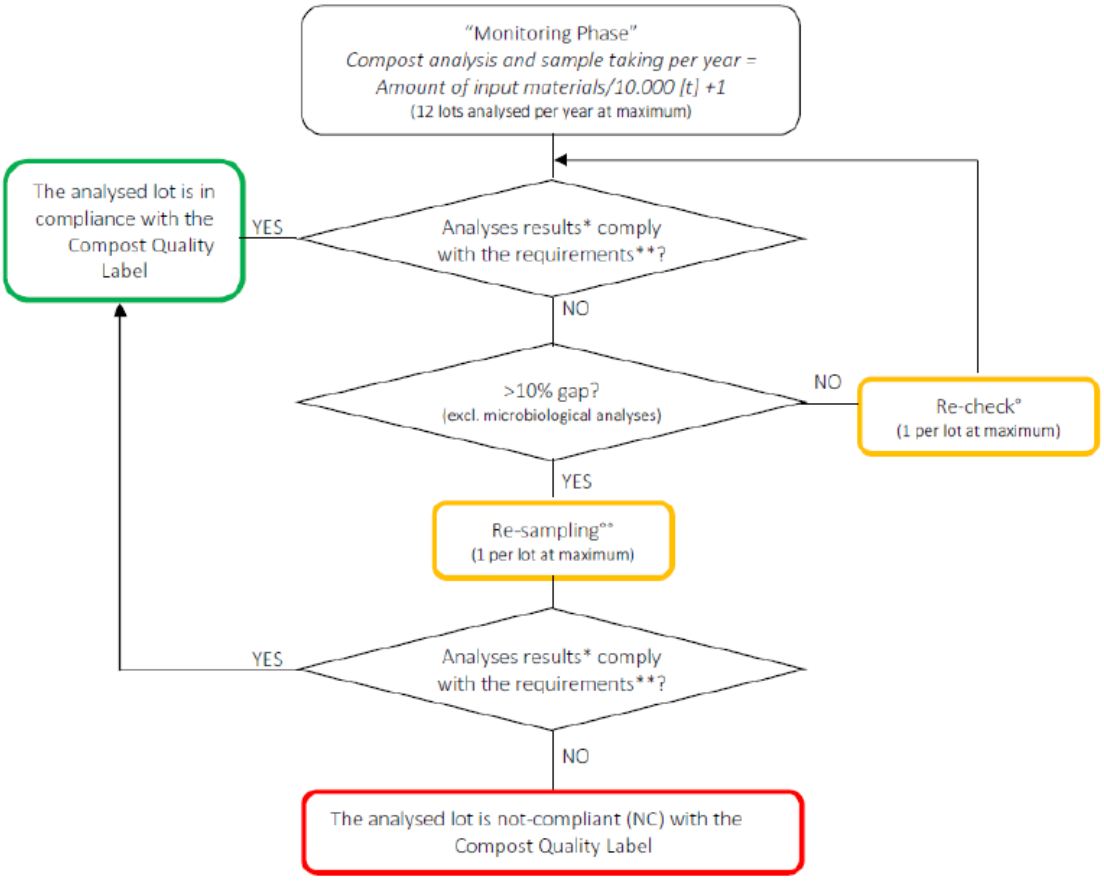


Figure 4.2. QL's Monitoring phase

The first one is the "Recognition phase", for new plants and/or new products to join the quality program. The necessary samplings and controls are taken by auditor's Specialists and one of the accredited Laboratories does the analyses. Depending on the type of the product, 2 or 4 analyses on different lots of production are carried out (2 analyses for GreenWaste compost, 4 analyses for Biowaste Compost and Compost from sludge). As the outcome of the "Recognition phase", together with successful analyses results, the product awards the QL and the plant gets the licence to use the label to promote the awarded product.

After the "Recognition phase", the production plant enters the "Monitoring phase", a continuous supervision by the auditor about the quality of the compost produced to grant the licence obtained during the first phase.

QLs are based on the limit values for use of biowaste as a secondary material (fertilizers or soil improvers) set by the National Laws for the most important environmental parameters (chemical, physical and microbiological parameters). Nutrient composition is tested and is not regulated.

Table 4.2: Parameters checked in QL audits

PARAMETER	M.U.	GREEN COMPOST (GC)	MIXED COMPOST (MC)	COMPOST FROM SLUDGE
Moisture content	% f.m.	≤50	≤50	≤50
pH	-	6-8,5	6-8,8	6-8,8
Organic C	% d.m.	≥20	≥20	≥20
Humic and fulvic acids	% d.m.	≥2,5	≥7	≥7
Organic N	%Ntot (d.m.)	≥80	≥80	≥80
C/N	-	≤50	≤25	≤25
Cu	mg/kg d.m.	≤230	≤230	≤230
Zn	mg/kg d.m.	≤500	≤500	≤500
Pb	mg/kg d.m.	≤140	≤140	≤140
Cd	mg/kg d.m.	≤1,5	≤1,5	≤1,5
Ni	mg/kg d.m.	≤100	≤100	≤100
Hg	mg/kg d.m.	≤1,5	≤1,5	≤1,5
CrVI	mg/kg d.m.	≤0,5	≤0,5	≤0,5
Tl	mg/kg d.m.	≤2*	≤2*	≤2*
Impurities (Plastic, glass and metals ≥ 2 mm)	% d.m.	≤0,5	≤0,5	≤0,5
Stones ≥ 5 mm	% d.m.	≤5	≤5	≤5
Salmonellae	MPN/25g	Absent	Absent	Absent
E.coli	CFU/g	≤1.000	≤1.000	≤1.000
Germination index (30% dilution)	%	≥ 60	≥ 60	≥ 60
PCB**	mg/kg d.m.	-	-	0,8

*For compost containing algae
** Up to 30% of sewage sludge into feedstock (d.m. basis)

The necessary samples are taken by auditors' and analysed by accredited laboratories using recognized methods. The number of samples per product is calculated on the basis of biowaste input:

n° of analyses per year = X10.000 +1 where X = authorized tons to be treated into the plant

(the number is always rounded off upwards)

Laboratories, in order to be accredited to make the analyses within the QLs programmes, have to take part and pass regular ring test for compost analyses, and provide the results to the auditor.

Besides the analyses carried out within the QL Program, the treatment plants are themselves obliged to take product samples for analysis for internal quality assurance.

The following methods are used by the Laboratories to analyse the compost samples within the QL Programmes:

Table 4.3: Methods applied for compost analyses

Parameter	Method
Moisture content	UNI EN 13040:2008 UNI EN 10780:1998 app. C1
pH	UNI EN 13037:2012 ANPA 3/2001 metodo N.8 EPA 9045D 2004
Conductivity	UNI EN 13038:2012 UNI 10780:1998 APP. D1
Organic C	DM 21/12/2000 GU n°21 26/01/2001 Suppl. n°6 UNI 10780:1998 APP.E
Humic and Fulvic Acids	DM 21/12/2000 GU n.21 26/01/2001 Supp.6 Manuale ANPA 03/2001 metodo n.11 UNI 10780:1998 App. F
Organic N	UNI EN 13654-1:2001 ISO 11261:1995 Reg. CE 2003/2003 13/10/2003 GU CEE L304 21/11/2003 all. IV Met 2.1 UNI 10780:1998 App.J.1. UNI 10780:1998 APP. J.3.1.
N tot	UNI EN 13654-1:2001 ISO 11261:1995 UNI EN 10780:1998 app. J.1
Organic N / N tot	calculated
C/N	calculated
Salinity	Manuale ANPA 03/2001 Metodo n.9 UNI 10780:1998 App. D1 DGRV 09/08/2005 SO BURV n°89 20/09/2005
Na	UNI EN 13650:2002 UNI EN ISO 11885:2009 UNI 10780:1998 App. B EPA 3050B 1996 + EPA 6010C 2007
Cd	UNI EN 13650:2002 UNI EN ISO 11885:2009 UNI 10780:1998 App. B EPA 3050B 1996 EPA 6010C 2007
Cr VI	ANPA Met. 16 Man. 3 2001 UNI 10780:1998 App. B
Hg	ISO 16772:2004 ANPA 15.3.4.2 Man. 3 2001 UNI 10780:1998 App. B

Parameter	Method
Ni	UNI EN 13650:2002 UNI EN ISO 11885:2009 EPA 6010C 2007 EPA 3050B 1996 UNI 10780:1998 App. B
Pb	UNI EN 13650:2002 UNI EN ISO 11885:2009 EPA 6010C 2007 EPA 3050B 1996 UNI 10780:1998 App. B
Cu	UNI EN 13650:2002 UNI EN ISO 11885:2009 EPA 6010C 2007 EPA 3050B 1996 UNI 10780:1998 App. B
Zn	UNI EN 13650:2002 UNI EN ISO 11885:2009 EPA 6010C 2007 EPA 3050B 1996 UNI 10780:1998 App. B
Salmonellae	DM 27/01/2014 Rapporti ISTISAN 2002/3 APAT 20/2003 - Cap. 3 Pag. 27
E.coli	DM 27/01/2014 UNI 10780:1998 FD CEN/TR 15214-1.2006 DM 08/07/2002 SO GU n°179 01/08/2002 Rapporti ISTISAN 02/08
Impurities (Plastic, glass and metals ≥ 2 mm)	Manuale ANPA 03/2001 metodo n.4 UNI 10780:1998 App. A
Germination index (30% dilution)	UNI 10780:1998 UNI 10780:1998 App. K
Stones ≥ 5 mm	Manuale ANPA 03/2001 Metodo n.4 UNI 10780:1998 App. A

4.4. Quality requirements for compost and digestate

Currently, quality standards require, inter alia, the declaration of the following aspects:

- ✓ plant nutrients,
- ✓ declaration of the compost according to the DE DüMV (see Chapter 4),
- ✓ determination of fertiliser and humus value,
- ✓ physical parameters (bulk density, dry matter (DM), rotting degree, etc.),
- ✓ biological parameters (salmonella, odour, etc.), and
- ✓ heavy metal content.

The declaration of properties of the compost or digestate also guide farmers and landscapers in the proper application of the products. In order to be certified according e.g. to the RAL quality standards, compost or digestate has to meet specific quality requirements. The five major aspects are:

- harmlessness,
- usefulness,
- appearance,
- reliability, and
- marketability.

Harmlessness

As compost or digestate are mainly used as fertiliser and soil improver, their harmlessness must be guaranteed. For this purpose, the respective RAL quality standard defines exact quality requirements. These are differentiated for compost (mature, fresh, substrate), digestate (liquid, solid), digestate from renewable raw materials (liquid, solid) and compost produced from sewage sludge. As an example, requirements and limit values for matured compost are presented in Table 2.

Usefulness

The levels of the nutrients nitrogen, phosphate, potassium and lime, as well as the humus value are determined during the compost and digestate analysis. The levels of nutrients must be taken into account by farmers in their calculation of the amount of fertiliser to be applied on land. From the levels of nutrients, the fertiliser value of the compost can be calculated in relation to mineral fertiliser. When using compost, the farmer can reduce the amount of mineral fertiliser used, which saves him money. Another positive effect of using compost is the supply of humus-C to improve or maintain the soil fertility and the water retention in the soil.

Table 4.4: Quality requirement standards according to the RAL quality standard (RAL-GZ 251)

Quality characteristics	Quality requirements
Sanitation	▸ Proof that can be tested on epidemic-hygienic effectiveness of the decomposition process (compliance test or "Konformitätsprüfung") ▸ Compliance with time and temperature requirements (process control) ▸ Exclusion of germinable seeds and sprouting plant parts ('free' means ‹ 2 plants/l compost) ▸ Exclusion of salmonellae
Impurities (limit values)	▸ Max. 0.5 weight-% in DM selectable, species-inappropriate material › 2 mm diameter ▸ Total surface area of impurities ‹ 25 cm²/l FM (if more impurities than 0.1 weight-% DM were found) ▸ Stones › 10 mm: max. 5 weight-% in DM
Tolerance of plants	▸ Plant compatibility for the provided area of application ▸ Free of phytotoxic substances, not nitrogen fixing
Rotting degree	▸ IV or V*
Water content	▸ Bulk material max. 45 % ▸ Bagged material max. 35 % ▸ Higher contents of water are admissible for compost with more than 40 % ignition loss according to Annex 4 of the BGK Methods Book
Organic matter	▸ At least 15 weight-% in DM measured as ignition loss
Heavy metal content (limit values) [mg/kg DM]	▸ Cd: 1.5; Cr: 100; Cu: 100; Hg: 1.0 ▸ Ni: 50 ; Pb: 150; Zn: 400;
Declaration	▸ Product type (matured compost) ▸ Name of producer ▸ Bulk density (volume weight) ▸ DM content ▸ pH-value ▸ Salt content ▸ Plant nutrients (total) (N, P_2O_5, K_2O, MgO, CaO) ▸ Plant nutrients (soluble) (N, P_2O_5, K_2O) ▸ Micro-nutrients (according to fertiliser legislation) ▸ Organic matter ▸ Alkaline effective matter (CaO) ▸ Net weight or volume ▸ Instructions for proper use

Appearance

Separately collected bio-waste enables the production of compost that differs not only in its physical appearance, but also regarding its content of pollutants and impurities from compost produced from mixed residual waste. However, even in the separately collected bio-waste, misthrows are always contained, which are still included in the finished product. A series of measures should be taken in order to reduce the contents of impurities, in particular of glass and of plastics. The requirements of the RAL quality standards in relation to impurities are stricter than the ones of other European standards. This is an advantage, because compost that contains impurities does not leave a good impression on the end-users and is not marketable in the long term. Therefore, the production of good-looking compost and digestate is an essential task of composting and digestion plants.

Reliability

Continuous assessments of the incoming bio-waste, of the composting and digestion processes and of their products according to the RAL quality standards guarantee sanitation and high quality of the certified products. Basically, certified compost and digestate have a consistent quality and the levels of contaminants are far below the limit values. Consequently, customers can rely on the products' constant quality.

Marketability

Only compost and digestate with low polluting potential, an appropriate composition of nutrients, good appearance and a reliable quality can easily be marketed.

4.5. Sample taking

The testing of a sample of compost or digestate allows the verification of compliance with the quality requirements. Proper sample taking is crucial to achieve meaningful analytical results. The performance of the testing within the quality assurance process.

The samples must be representative for an entire batch of compost or digestate. A batch is defined as a unit, produced under the same conditions and at the same time. It must be differentiated between three types of samples:

Individual sample, as a small portion taken of any point of the batch,

Collective sample, as the total quantity of all individual samples from a batch, and

Laboratory sample, as a small part of the collective sample, reduced to the quantity needed to carry out the laboratory and hygiene test.

When selecting the sample taker and the laboratory for the analysis, there are a number of criteria to consider. These are listed in Table 4.5.

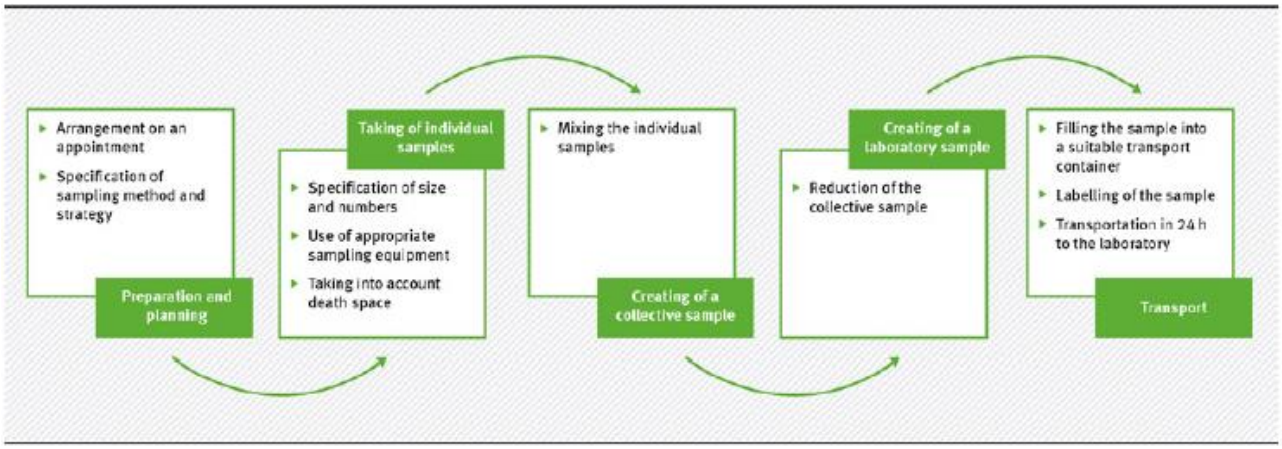
Table 4.5: Requirements for sample takers and laboratories

Sample takers	Laboratories
Accredited by the BGK	Accredited by the BGK
Independent	Having established a quality management system (e.g. ISO 17025)
Participating in regular training courses every three years	Having experience with all test methods
Having practical experience with relevant standards (EN 12579:2000; EN ISO 5667-13:2011)	Regular and successful participation in roundrobin tests
	Standardised reporting of results

The process of sample taking can be divided into five steps:

1. Preparation and planning,
2. Taking of individual samples,
3. Creating of a collective sample,
4. Creating of a laboratory sample, and
5. Transport.

Table 4.6: Process of sample taking



First of all, an appointment for the sample taking at the composting or digestion plant has to be arranged. Before taking the sample, the type of the sample as well as the method and strategy of sample taking has to be defined. Questions that need to be clarified are:

- ✓ Which is the purpose of sample taking (internal/external quality control)?
- ✓ Which are the relevant sampling methods (EN ISO Standards/ Methods books)?
- ✓ Which product should be sampled (intermediate product/input material)?
- ✓ At what point should be sampled (stored material, moving material, packaged material)?

Taking of individual samples

It is important that the individual samples are taken evenly dispersed over the entire batch and that all have the same size. The size and number of the samples are depending on the material and the batch size.

Table 4.7: Sizes and numbers of individual samples

Solid material	
Size, if grain size ‹ 20 mm	Min. 2 litre per individual sample
Size, if grain size › 20 mm	Min. 3 litre per individual sample
Number of individual samples , if volume of batch ‹ 500 m³	20 individual samples
Number of individual samples, if volume of batch ‹ 1,000 m³	40 individual samples
Liquid material	
Size per individual sample	Min. 1 litre per individual sample
Number of individual samples, if volume of batch ‹ 1,000 m³	Min. 12 individual samples
Number of individual samples, if volume of batch ‹ 3,000 m³	Min. 20 individual samples
Number of individual samples, if volume of batch ‹ 5,000 m³	Min. 30 individual samples

The selection of the appropriate sampling equipment depends on the consistency of the batch. While a wheel loader, metal shovel/hoe, containers, screw drillers, and square rubber or plastic sheets are used for the sample taking of solid material, for liquid material a vessel to collect and mix the individual samples, a pump to extract the samples, a sample scoop and lockable packaging vessels for the final sample are necessary. When taking the sample, death space volume needs to be taken into account. These are the sections of the pipeline to the sample taking taps, where the material does not drain continuously. Therefore, dead spaces must be sufficiently flushed before taking the sample.

Creating a collective and a laboratory sample

All individual samples are spread out on a rubber or plastic sheet and are mixed. This collective sample is divided into four equal squares with two opposing squares selected to create a new sample. This process is repeated until the appropriate size of the laboratory sample (at least 20 litres) is remaining.

Transport

The last step is the filling of the laboratory sample into a suitable container for transport purpose. This container should be labelled with the following facts:

- ✓ origin of the sample batch,
- ✓ date of sample taking, and
- ✓ name of the sample taker.

The transportation to the laboratory should proceed within 24 hours, while the sample is cooled constantly. Finally, after each sample taking, all sampling equipment must be thoroughly cleaned.

5. Summary - Outline.

The requirements for quality assurance and certification are defined by a standard setting institution. Certified auditors implement these requirements and awards qualified products (compost and digestate) the respective QLs. Further tasks of the auditor are, inter alia, advising its issuers, public relations, and the promotion of research and development.

In order to review the quality of compost and digestate according to defined quality requirements, the auditor accredits and approves independent sample takers and laboratories. Therefore, an accreditation procedure for both, the sample takers and the laboratories, has been established by the auditor.

Plant operators wishing to depict a QL have to pass the quality assurance process conducted by the auditor. This includes sample taking during a site visit by an auditor's sample taker and subsequent analysis of the sample by an accredited laboratory. The objective is that the operator proves to the auditor's quality advisor that he is able to ensure the self-control during the plant operation. Once the production process, the intermediate and final products, as well as the plant itself fulfil all QL requirements, the compost and digestate produced by the plant can be awarded the QL.

General steps towards a QAS

When thinking of introducing a QAS and reflecting, which properties and experiences of the QAS and its QAO may be of interest for designing and establishing a QAS, it is recommended to focus first on functions, which a QAS shall perform, and then on organisational aspects.

The range of possible functions could comprise:

- developing quality standards for compost and digestate that at least meet the requirements of the respective acts and ordinances to increase the acceptance of compost and digestate as new products,
- regularly monitoring the composting or digestion process at the plant and the compost or digestate at the plant in order to assess the compliance with the required quality standards, including regular sample taking of the compost or digestate and regular analysis of the compost or digestate samples according to the respective requirements,
- (if appropriate) designing a quality label to make the product's quality easily visible (consequently, integrating a process for awarding the label into the process of the quality assurance),

- monitoring the whole quality assurance process and, if requested, awarding the label,
- training and accrediting independent sample takers and laboratories,
- developing an appropriate pricing and financing system.

Which organisations could perform which functions, can only be decided upon when assessing existing institutional structures and options for new structures in the particular framework conditions.

In any case, in order to achieve effective bio-waste treatment and subsequent use, following steps should be considered:

- ✓ implementing and enforcing the respective ordinances concerning the separate collection and the treatment of bio-waste,
- ✓ facilitating the construction of sufficient composting and digestion plants,
- ✓ facilitating that sufficient capacities for sample taking and analysis are available,
- ✓ if appropriate, supporting the promotion of quality assured compost and digestate to further develop and improve the marketability for these products.

According to experiences, a QAS with high quality standards and a reliable monitoring improves the quality of compost and digestate – and as a consequence can improve their marketability. It has proven to be a good supporting instrument in increasing composting and digestion activities and therefore to decrease the amount of biodegradable waste being landfilled and to increase material recycling.

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