AGRISED – Project LIFE17 ENV/IT/000269

“Use of dredged sediments for creating innovative growing media and technosols for plant nursery and soil rehabilitation"

Overview of national and EU legislation

Action A.1

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1. Introduction

This document summarizes the current dimensions of the sediment dredging and green waste activities, and the current management strategies of dredged sediments and pruning residues in Europe, Italy and Czech Republic. It also provides estimates on the market and trends of growing media for professional plant nursery industry and soil amendments in the European Union, with a focus for Italy and Czech Republic, examines the relevant environmental and agricultural legislation, and illustrates the AGRISED strategy for the potential inclusion of the dredged sediments reclaimed by co-composting with green waste as soil amendment and professional growing media for the plant nursery industry. The results obtained from the demonstration trials will be evaluated in terms of technological innovation to overcome the eventual end-user skepticism, as the sediment-based growing media are considered to be of low quality and less competitive as compared to the traditional peat- and coir pith based soil amendments and growing media. A business model accounting for the eventual differences in labor intensity and market orientation for plant production and marketing of plants produced on the novel growing media.

2. The AGRISED core activity at a glance

Sediments are considered a waste deriving from the dredging activities of rivers, canals, lakes harbors and ports. If not contaminated, they can be used as secondary raw materials for various engineering processes and as filling materials, whereas their use as soil amendments or growing media for professional plant nursery is not admitted.

Green waste and pruning residues belong to the waste families admitted to the production of fertilizer, soil amendment and professional plant growing media, either as such or after processes encoded by the D.lgs n. 75/2010 (D.M. 5 February 1998, sub-attachment1, point 18,9).

Currently, the plant nursery sector use peat- or coir pith-based growing media for the production of floriculture and for ornamental plant production. Such materials have a high environmental impact and need to be replaced.

In compliance with Italian Environmental Legislation, (art. 184-ter, A.lgs n. 152/2006), an end of waste qualification can be achieved when a waste material undergoes to a recovery operations, included the recycling and the preparation for its re-use, and satisfies the following criteria and conditions: a) the substance or the object commonly is used for specific scopes, b) a market or a question for such substance or object exists, c) the substance or the object satisfies technical requirement for the specific scopes and respects the norm and the existing standards applicable to the produced ones, d) the use of the substance or of the object it will not cause negative overall impacts on the atmosphere or the human health.

The AGRISED thesis is that sediments with moderate or no contamination, if subjected to a bioremediation process such as co-composting with green waste, can achieve physical chemical and microbiological chemical comparable to those of commonly used soil amendments and plant growing media listed in the D.lgs n. 75/2010. Accordingly, the materials produced by co-composting of sediments and green wastes can achieve an end of waste qualification because recovered with a simplified procedure according to the art. 216, D.lgs n. 152 of 2006 and the D.M. 5 February 1998, given that it will be used as soil amendment or professional growing media for ornamental non food plants in compliance with the d.lgs n. 75 of 2010, and it is distributed by a registered company according to the codicil third of art. the 216.

The sediment-based growing media and soil amendments can be commercialized only if satisfy the technical requirements in the regulations (EC) n. 2003/2003 of the 13/10/2003 and in the d.lgs n. 75 of 2010 (art. 4, codicil 1, D.lgs n. 75) imposing the labelling, the traceability and the preliminaty registration of the manufacturer in the "Registry of the fertilizer manufacturers" (art. 8, D.lgs n. 75). The sediment-based soil amendment and plant growing media must fulfill the indications of art. 9, codicil 1, lett. a), regulation (EC) 2003/2003 on the packaging (art 3 D.lgs n. 75) and on the accompaniment document (articles. 7 and 9, reg. EC n. 2003/2003 of the 13/10/2003).

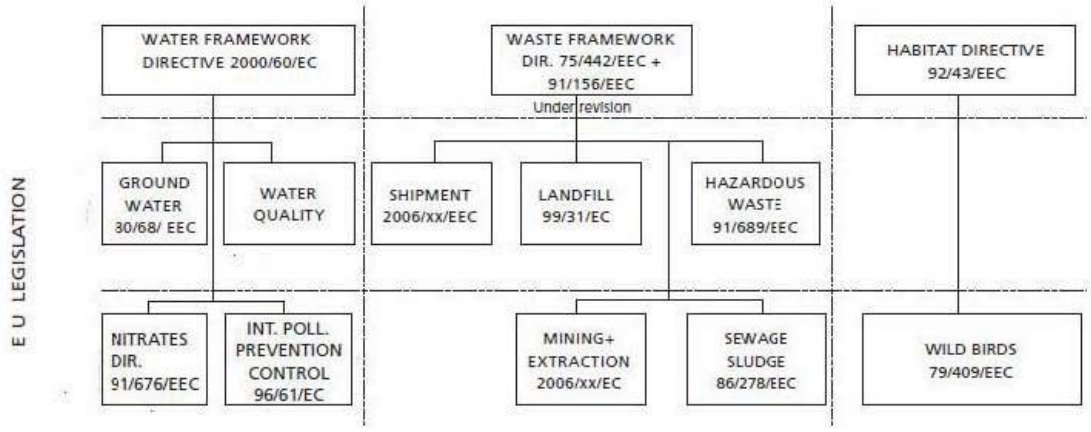
In conclusion, the sediment-based soil amendment and plant growing media can achieve the end of waste qualification and can be introduced in the fertilizer market only if all the above conditions are fulfilled.

3. Sediment management in Europe, Italy and Czech Republic

3.1. The European scenario

Sediment management is a major environmental issue in Europe, and has been discussed since the beginning of Seventies in the ambit of specific international conventions and EC directive (Table 1). Regular dredging is necessary to keep waterways navigable and to prevent rivers from flooding, however, among the legislatures of all European countries, there are no specific international or regional conventions on dredged material and there are no specific directives (Figure 1). The conventions that already exist are focused on the prevention of the impact of dumping activities on the marine environment, while the European Community Directives are related to water, soil, waste and landfill. Currently, the EU legislation is still unclear on the possibilities of dredged sediments as by-products recyclable in agriculture, and with marked differences among European Countries that still rely on individual national legislations or regulations by local authorities.

Figure 1. Relevant EU Directives influencing the management of dredged materials. (Modified by Mink et al., 2006).



A clarification of the legislation on the possibilities of using dredged sediments as components of growth media for ornamental plants, as in AGRISED, is necessary to allow the EU-wide use of reclaimed sediments in agriculture, particularly for the cultivation of ornamental plants. There is a growing concern of the need of sediment quantity and quality management to really fulfill the European Water Framework Directive. Currently, none of the EU environmental Directives deal specifically with dredged material, but three main Directives have a direct or indirect impact on sediment management (Figure 1 in attachment): the Water Framework Directive (2000/60/EC), the Waste Framework Directive (75/442/EEC, 91/156/EEC), and the Habitat Directive (92/43/EEC).

Table 1. Main international Convention and EC Directive

Oslo Convention (1972)	**Convention on Prevention of Marine Pollution by Dumping from Ship and Aircraft**
London Convention, Protocol 96 (1972)	Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter
Paris Convention (1974)	Convention on the Prevention of Marine Pollution from land-based sources
OSPAR Convention (1992)	Convention for the Protection of the Marine Environment of the North-East Atlantic
Barcelona Convention, Dumping protocol (1995)	Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean
Directives 1999/31/CE (the first EU waste and water directives)	Directive on the landfill of waste; it has a limited impact on the disposal of dredged material along waterways on agricultural land or suitable subaquatic locations are acceptable solutions, but concentrations of contaminants must remain below certain limits.
EU Parliament Decisions 2000/532/CE	Decision on hazardous waste, amended with the Decisions 20001/118/CE, 2001/119/CE and 2001/573/CE, established the European Waste Catalogue, where hazardous wastes are defined.
Directive 2000/60/CE (Water Framework Directive)	Directive of the European Parliament and of the Council (Water Framework Directive), establishing a framework for Community action in the field of water policy: protection of all waters, protection and enhancement of the status of aquatic ecosystems. (Concerning dredged sediments: member States are required by law to submit proposals for quality standards applicable to the concentration of the main substances in surface water, sediments or biota).
Decision 2455/2001/EC	Decision of the European Parliament and of the Council, establishing the list of priority substances in the field of water policy and amending directive 2000/60/EC.
Directive 2008/32/EC	Directive of the European Parliament and of the Council amending Directive 2000/60/EC establishing a framework for Community action in the field of water policy, as regards the implementing powers conferred to the Commission.
Directive 2008/56/EC	Directive of the European Parliament and of the Council (Marine Strategy Framework Directive), establishing a framework for community action in the field of marine environmental policy, within each Member States shall take the necessary measures to achieve or maintain a good environmental status in the marine environment by the year 2020 at the latest.
EU 'Waste Directive' (Directive 2008/98/CE)	Directive of the European Parliament and of the Council on waste and repealing certain Directives; it lays down measures to protect the environment and human health by preventing or reducing the adverse impacts of the generation and management of waste and by reducing overall impacts of resource use and improving the efficiency of such use. (Concerning dredged sediments: they are linked to waste because it is not yet clear if they should be considered waste or not waste. Art. 2.3 of the Directive assesses that "*Sediments relocated inside surface waters are excluded from the scope of the Waste Directive when they are not hazardous and when they are relocated for the purpose of: managing waters and waterways, preventing floods, mitigating the effects of floods and droughts, land reclamation*").
Directive 2008/105/EC	Directive of the European Parliament and of the Council on environmental quality standards in the field of water policy, amending and subsequently repealing Council Directives 82/176/EEC, 83/513/EEC, 84/156/EEC, 84/491/EEC, 86/280/EEC and amending Directive 2000/60/EC of the European Parliament and of the Council; it lays down environmental quality standards (EQS) for priority substances and certain other pollutants as provided for in Art. 16 of Directive 2000/60/EC, with the aim of achieving good surface water chemical status and in accordance with the provisions and objectives of Art. 4 of that Directive.
Directive 2009/90/EC	Directive of the Commission laying down, pursuant to Directive 2000/60/EC of the European Parliament and of the Council, technical specifications for chemical analysis and monitoring of water status; it lays down technical specifications for chemical analysis and monitoring of water status in accordance with Article 8(3) of Directive 2000/60/EC. It establishes minimum performance criteria for methods of analysis to be applied by Member States when monitoring water status, sediment and biota, as well as rules for demonstrating the quality of analytical results
Directive 2013/39/EU	Directive of the European Parliament and of the Council amending Directives 2000/60/EC and 2008/105/EC as regards priority substances in the field of water policy.

3.2 The Italian legislation on sediment management

This paragraph illustrate the main National legislation regulating the sediment dredging activities, management and potential reuse of dredged sediments, which is also summarized in Table 2.

Until 1997 the sediments were mainly dredged and simply disposed along the canals. From 1997, with the *LG.D.* (Legislative Decree) *n. 22/1997*, the dredged sediments were identified as wastes (Figure 2). A wide range of unclear regulations on sediment management have occurred (succeeded each other) from 1997 (Table 2.) Some of these regulations concern port dredged material, others are about general activities on surface waters or attain dredging operations inside remediation National Priority Sites (SIN). Some provisions deal with disposal at sea, others with re-use, others with the disposal in containment facilities. Other norms exclude dredged materials from the legislation on waste management or admit the possibility that, under certain conditions, they could be qualified as by-products. Most relevant legislation on sediment management are *LG.D. n. 152/2006*, *LG.D. n. 205/2010*, Ministry Decree *M.D. n. 161/2012*, whereas more recent regulations *LG.D. 91/2014* converted into Law (*L. 116/2014)* and *LG.D n. 133/2014* converted into (*L. 164/2014*) that have introduced new changes on sediment management.

In *LG.D n. 152/2006* for the first time the sediments were not considered waste if their 'movement' was carried out for specific purposes (e.g. waterways management, shore consolidation) and if they were not dangerous. The *LG.D. n. 205/2010* clarified the exclusions of a product from the waste legislation (end of waste qualification).

The *M.D. n. 161/2012* updated the sediments classification and management, by defining the sediments as excavated material, and introducing terms and conditions at which excavated materials could be reused as by-products and thus managed according to the end of waste process. In particular, the use of excavation materials as by-products was guaranteed when the content of pollutants in the excavation materials was lower than the contamination threshold concentrations (CSC), listed in the columns A and B of Table 1 attached to the Title V part IV of the *LG.D. n. 152/2006* and s.m.i., with reference to the specific urban use or to the natural background values.

The *M.D. n. 161/2012* was abrogated and replaced by *LG.D DPR 120/2017* in which the sediments were excluded from the list of excavation materials because included in other regulations, namely:

i) *M.D 172/16* related to the dredging operation in SIN

ii) *LG.D. 91/2014* (converted into *L. 116/2014*)

iii) *LG.D n. 133/2014* (converted into *L. 164/2014*).

The *LG.D n. 91/2014* integrate the Art. 184-quater of *LG.D n. 152/2006* with four important paragraphs for sediment management and recycling, relevant for AGRISED project:

Specifically in Paragraph 1 it is stated that:

a) "...dredging materials subjected to recovery operations in confined tanks or in other authorized plants can be qualified as 'end of waste' when they do not exceed the values of the contamination threshold concentrations (CSC), columns A and B of Table 1 attached to the Title V, part IV, of the *D.Lgs n. 152/2006* and its subsequent amendments and additions, with reference to the urban destination of the site of use."...

b) "...the site of destination must be previously defined and the sediments are used directly, without risk for the environmental matrices concerned and in particular without causing contamination of ground and surface water."

Paragraph 2 specifies that: "In order to prevent risks of contamination of groundwater, dredging materials reused on a site must be subjected to leaching tests that must conform to methods and limits present in the Annex 3 of the *M.D. 5 February 1998*. The competent authority may derogate from the limit concentrations for chlorides and sulfates if the dredging materials are destined for coastal areas and are compatible with the salinity levels of the soil and water table."

Moreover, the paragraphs 3, 4, and 5 strictly define the procedures in the following way:

Paragraph 3. The manufacturer or the holder shall prepare a declaration of conformity showing, in addition to the data of the manufacturer, the holder and the user, the type and quantity of the materials to be used, the recovery activities carried out, the site of destination and the other methods of use envisaged and the declaration that the criteria set out in this article are respected. The declaration of conformity is presented thirty days before the start of the transfer operations to the responsible Authority for the recovery procedure and to ARPA in whose territory the destination site or the production cycle of use is located. All the subjects involved in the recovery and use of the materials referred to in this article shall keep a copy of the declaration for at least one year from the date of issue, making it available to the competent authorities requesting it.

Paragraph 4. Within thirty days from the communication of the declaration of paragraph 3, the responsible Authority for the recovery procedure verifies the compliance with the requirements and

procedures regulated by this article and in case of anomalies or violations thereof it prohibit the use of the materials referred to in paragraph 1, which remains under the waste regime legislation.

Paragraph 5. Materials that are qualified as non–waste according to paragraphs 1 and 2 during movement must be accompanied by the communication referred to paragraph 3 and the transport document, or by a copy of the transport contract according to the articles 6 and 7-bis of the *LG.D n. 286/2005*. Finally, the *LG.D n. 133/2014* converted into *L. 164/2014* excludes the sediments from the regulation on waste in case they were moved within the hydraulic appurtenances.

The specific Italian legislative framework related to excavation and dredged materials is summarized in Figure 2.

Figure 2. CER codes included in the annex of the Italian D.Lgs 5 febbraio 1997, n. 22 and of the Decision 2000/532/CE, as modified by the decisions 2001/118/CE, 2001/119/CE and 2001/573/CE.

Elenco dei rifiuti e dei codici CER di cui agli allegati al D.lgs. 22/97		**Decisione 2000/532/CE come modificata dalle Decisioni 2001/118/CEE, 2001/119/CE e 2001/573/CE**	
Codice CER	Definizione	Codice dell'elenco dei rifiuti e definizione rifiuto **pericoloso**	Codice dell'elenco dei rifiuti e definizione rifiuto **non pericoloso**
17	**RIFIUTI DI COSTRUZIONI E DEMOLIZIONI (COMPRESA LA COSTRUZIONE DI STRADE)**	**17**	**RIFIUTI DELLE OPERAZIONI DI COSTRUZIONE E DEMOLIZIONE (COMPRESO IL TERRENO PROVENIENTE DA SITI CONTAMINATI)**
1705	**Terra e materiali di dragaggio**	**1705**	**Terra (compreso il terreno proveniente da siti contaminati), rocce e fanghi di dragaggio**
170501	terra e rocce	170503*	terra e rocce, contenenti sostanze pericolose	170504	terra e rocce, diverse da quelle di cui alla voce 170503
170501	terra e rocce	170507*	pietrisco per massicciate ferroviarie, contenente sostanze pericolose	170508	pietrisco per massicciate ferroviarie, diverso da quello di cui alla voce 170507
170501	terra e rocce			191209	minerali (ad esempio sabbia, rocce)
170502	terra di dragaggio	170505*	fanghi di dragaggio, contenenti sostanze pericolose	170506	fanghi di dragaggio, diversi da quelli di cui alla voce 170505

Table 2. Resume in chronological order of law that have directly addressed the topic of sediment management during from the end of the 1990s[1].

***LG.D. n. 22/1997*: it is the first legislation affecting environmental issues. Annex I is the *European Waste Catalogue* (*E.W.C.*) identifying with the code 17 05 00 the *dredged soil and materials* and with the code 17 05 02 the *dredged soil*. This Decree has been abrogated and replaced by LG.D. n. 152/2006.**
***M.D. 05.02.1998*: it is the unique legislation for inland reuse of dredged material but unfortunately only related to inland waters; it identifies *non-hazardous waste* that, according to LG.D. n. 22/1997 (today 152/2006), may be subject to simplified procedures for recovery (the recovery may be started 90 days after a simple communication to the competent Province). Annex I (Item 12.1) to the M.D. identifies the possible recovery operations that may be conducted on dredged mud deriving from *«dredging of lakes bottom, ship or irrigation canals and water courses (internal waters), cleaning of water basins»*: construction of road embankments and pavements; construction of embankments and dams with no direct or indirect contact with the marine environment; profiling of parts of the riverbed morphometry; "environmental restoration" when the material is compatible with the physical, chemical, hydrogeological and morphological area characteristics and concentration of contaminants are compatible with levels of current legislation for contaminated sites.**
***Article 35 LG.D. n. 152/1999*: it regards water protection against pollution. It implements Directive 91/271/EEC concerning urban waste-water treatment and Directive 91/676/CEE concerning protection of waters against nitrate pollution from agricultural sources. Article 35 allows the flow back to sea under authorization of *excavated materials from marine or salty bottoms or emerged coastal soils'*, provided that it is proved that there is the *'technical or economical impossibility to use them for the purposes of beach nourishment or recovery or alternative disposal'*. This LG.D. was abrogated and by the LG.D. n. 152/2006, in particular art. 109 (see below).**
***Article 109 LG.D. n. 152/2006*: it repeals the mentioned Article 35. This provision has recently been modified by D.L. n. 5/2012 (it removed the condition concerning the *«technical or economical impossibility to use them for the purposes of beach nourishment or recovery or alternative disposal»*).**
***Article 13 LG.D. n. 205/2010*: it has entirely modified Article 185 of LG.D. n. 152/2006 dedicated to exclusions from the waste legislation; paragraph 3 of Article 185 textually reproduces what provided by Directive 2008/98/EC: *«without prejudice to obligations under other relevant Community legislation, sediments relocated inside surface waters for the purpose of managing waters and waterways or of preventing floods or mitigating the effects of floods and droughts or land reclamation shall be excluded from the scope of Part Four of this Decree if it is proved that the sediments are non-hazardous pursuing Commission Decision 2000/532/EC»*.**
***Article 39, par. 13 of LG.D. n. 205/2010*: it specifies that the notion of *by-product* also applies *«to the material removed, exclusively for hydraulic security reasons, from the bed of rivers, lakes and creeks»*.**
***M.D. n. 161/2012*: it regulates terms and conditions at which *excavated materials* may be reused as *by-products* and thus managed as *non-waste*. This regulation applies also to *«lithoid material in general and anyway all the other possible granulometric fractions coming from excavations made in beds of both surface water bodies and the dripping hydraulic network, in flood plains, beaches, sea and lakes bottoms»*. It was abrogated and replaced by LG.D DPR 120/2017**
***LG.D n. 91/2014 (Decreto Competitività), as converted into law by L. 116/2014:* introduces important changes in the regulation of dredging materials: new art. 184-quater of LG. D. n. 152/2006, which is specifically dedicated to the use of dredging materials**
LG.D n. 133/2014, as converted into law by L. 164/2014: Decreto sblocca-Italia
Art. 7, Comma 8-bis: art. 185, comma 3, del D.lg. 152/2006, Exclusion from the regulations on waste of sediments moved within the hydraulic appurtenances
***M.D. 172/16* regulation on the rules of the methods and technical standards for dredging operations in SNI**
***LG.D DPR 120/2017* the sediments were excluded from the list of "excavation materials" because included in other regulations**

[1]In the legislative Italian system there are: a) *primary sources of law*: the Law (L.), the Legislative Decree (LG.D.) and the Decree Law (D.L.); b) *secondary sources of law*: Regulations, taking the form of Decree of the President of the Republic (D.P.R.) or Ministerial Decree (M.D.).

3.3 The Czech legislation on sediment management

Sediments for agriculture:

In the Czech Republic, the use of waste materials is regulated by Act 185/2001 Col. "On the wastes". The §9a of the said Act defines the hierarchy of waste processing and management. According to §37t of the Act 185/2001 Col., par. 4: If sediments excavated from water body bottom shall serve as an Agricultural land resources amendment, neither the excavating entity, nor the land owner/user keeps the track record of the sediment use according to §39 par. 1 and does not report this use according to §39 par. 2 & 3. For such sediment application, there is a special regulation – the Decree 257/2009 Col. "Sediment application on Agriculture".

These sediments represent wastes, but are not regarded/managed as wastes, and thus, =>

- no waste evidence record is required to keep,
- no report on waste production is required,
- no authorized personnel required + no reporting of waste processing according to §14, par. 2 and no waste evidence, too.

Further, the Act 334/1992 Col. "On the Protection of Agricultural land", specifically the §3, par. 1 letter a) demands: "The rule of soil protection is to avoid contamination exceeding Indicative limits." Paragraph 3 claims that those soils found to exceed the set Indicative limits are banned from the application of WWT sludge. Decree 257/2009 Col. claims in §2 par. 3 that statement of §3 letter a) and b) does not apply in the case of dredged sediments.

Act 334/1992 Col. was amended with specific §3a, which directly adjusts the application of sediment on agriculture soil:

Par. 1: Use of sediments from water bodies on an agricultural soil is possible only in the case that it concerns true agriculture soil (fertile ground, Permanent Grass Lawn) after complying with the Act on fertilizers (156/1998 Col.) and only if the favorable physical, biological, and chemical soil properties are not compromised. All is managed according to rules of Decree no. 257/2009 Col.

Par. 2, among others, lists the following necessities:

b) Consent of the land owner or other authorized person;
c) Information on sediment testing not older than 3 yrs.;

f) Information on the soil quality, to which the sediment shall be applied in the extent required by specific law regulation;

g) Laboratory confirmation on sediment and soil sample collection, accreditation for sampling and analyzing both the relevant matrices is required;

h) It is necessary to mark the place of temporary storage of the sediment prior to application – provided it is stored on agriculture land.

Par. 3 The soil protection authority is allowed to require ecotoxicological tests in case of suspicion on the presence of risk substances or elements (that are not covered by the Decree no. 257/2009 Col.) with potential to damage favorable physical, biological, and chemical soil properties.

Further conditions of Decree 257/2009 Col.:

- Sediment grain size has a major importance, also the content of shells, etc.;
- Limited application doses are required: 3:1, max application dose in lower tonnes per 1 hectare (in case of raw sediment);
- Background levels of the soil to be treated- artificial pollution => necessary to check background levels;
- Required testing of sediments prior and after their excavation:
    - §2, par. 1 states that „Compliance with the limits is documented by a protocol of sediment analysis results, sampled prior to and after their excavation and by an accompanying list on the sample collection.“
    - In case the soil sample is collected for the background level verification, it is recommended the collection to be performed by an organization certified to collect soils for agrochemical testing = ÚKZUZ = Central Institute for Supervising and Testing in Agriculture (ÚKZUZ allows for other sampling as well, as long as it is comparable).

Other implications:

- §3 and §3a of Act 334/1992 Col. does not require soil sampling in all cases of sediment application:

- Soil testing is required in case, the rules of Act 257/2009 Col. demand so, provided the following:

- If the preventive limits according to Decree 153/2016 Col. are exceeded, the application of sediment is still possible, despite the tendency of the Act 334/1992 Col. to ban the application. The issue is the comparison of data according to the preventive (Decree 153/2016 Col.) vs. the indicative limits (§3, par. 1 Act 334/1992 Col.).

- Soil background level testing: For the application of sediment on agriculture land, most pertinent description of background level testing is included in Act 257/2009 Col.

- Soil structure is given by the grain size of particles > 2 mm. In practice, according to the soil skeleton type, the coarse sand (2 – 4 mm), gravel (4 – 30 mm), and pebbles (> 30 mm) are distinguished. **By definition, wood, leaves, and wastes that do not belong into the sediment are not a soil skeleton and shall be excluded by sorting prior to the application.**

Sediments treated as non-wastes:

As discussed above, also this subject is majorly governed by the Act 185/2001 Col. "On the Wastes". The most relevant parts in this respect are as follows:

- §2 par. 1: "... this law does not apply to sediments transported for (...), or soil re-cultivation, provided that the sediments do not exhibit any of the hazardous characteristics listed within the Annex of the directly applicable EU regulation on hazardous wastes (Annex III of Directive 2008/98/EC; further specified by the Decision 2000/532/EC establishing a List of Waste, as last amended by Commission Decision 2014/955/EU. Guidance on waste classification is also available.)."

- §37t par. 1:"sediments excavated from watercourses and water bodies, being considered a waste, may be applied to agricultural land in accord with §14 par. 2, only if the requirements of Act 257/2009 Col. are met."

- If the sediments excavated from watercourses and water bodies are delegated for application on an agricultural land, neither the entity of their origin, nor the entity applying the

sediments on the land is obliged to keep the evidence-record according to §39 par.1 and is not obliged to submit the evidence-report according to §39 par. 2 & 3. For these sediments are managed under a special legal regulation.

To apply sediments on agriculture land, the material must be legally treated as a non-waste, first. For this sake, there are two general options available:

Option 1: Sediments treated as Products, Goods, or ware:

- Key-feature here would be the quality with respect to limited or certified quality parameters - not necessarily, these parameters have to be composed of quality regarding the contaminants, but also of quality regarding the content of nutrients or grain size. The safe-use limitations suggested by the producer are of key importance in such case.
- The maneuvering space of the "Products Option" are quite wide – for example utilization of the Act 156/1998 Col. on fertilizers, soil improvers, auxiliary plant preparations and substrates and on agrochemical testing of agricultural soils (Fertilizer Act):
    - §1, par. 1d: "This Act applies to introducing, storing, and utilizing of sediments."
    - §1, par. 2b regarding the fertilizer testing in the Czech Republic: "This Act does not apply to: fertilizers, supportive soil substances, supportive plant preparations and substrates provided in amount necessary for the purpose of research, development, and experimenting. Relevant footnote 1: Council Directive 86/278 / EEC of 12 June 1986 on the protection of the environment, and in particular of the soil, when sewage sludge is used in agriculture. Relevant footnote 2: Regulation (EC) No 2003/2003 of the European Parliament and of the Council of 13 October 2003 on fertilizers, as amended.

Option 2: Sediments treated as side products/non-wastes made of waste:

- Related mainly to terrain infilling, or sediment-based non-waste or side products landfill disposal: quality requirements for sediment materials specified in table 10.2, 10.3, and 10.4 in annex of Act 294/2005 Col. (contaminant levels), or quality related to the limited or certified quality parameters such as nutrient content, grain size composition, etc.

Conclusion:

The option to exclude sediments from the diction of the Act on Wastes exists. Act 185/2001 Col. §2 par. 1g states, among others (a-f), that this Act does not apply to sediments transported within/from surface water bodies in the sake of water-course management, flooding prevention, flooding- or draught-effect mitigation, or soil reclamation, provided, the sediments do not exhibit any of the

hazard properties listed in the directly applicable EU directive 1357/2004 on hazardous waste properties. Further:

- Utilization of sediment as a construction material is admissible.
- Best option for the AGRISED project purposes: Utilization of sediment as a fertilizer, supportive soil substance, supportive plant preparation and substrate, under conditions provided by the Act 156/1998 col. as amended and according to Decree 474/2000 Col. on the specification of requirements for fertilizers as amended.
- Alternatively: Utilization of sediments as a side-product or as a non-waste made of waste (in case the sediment was accepted as a waste and it was treated subsequently), i.e., construction material in forms of relevant standards (river material – sand, gravel, cobbles, sandy-gravel, or similar mixtures) according to Act 185/2001 Col. §3 par. 5, par. 6, par. 7, or as a fertilizer according to Act 156/1998 on fertilizers.

4. Pruning residues: production and management in Europe, Italy and Czech Republic

Fruit tree growing in Europe is practiced on ca. 50 millions of ha. Woody residues from tree crops are among the major sources of biomass, with annual pruning yields ranging between 1and 5 tons of fresh matter per ha, with an estimate production in EU28 exceeding 13 million tons every year. There is systematic collection of data of pruning residues from private and public green areas and other sources of pruning from environmental maintenance operations, which make difficult a direct estimation of the production this type of biomass. Management of agricultural pruning residues can offer benefits in case or reuse or environmental problems where it is not reused and need disposal. It is estimated that ca. 13 million tons of wood pruning residues per year are produced in the countries of the European Union. While the European Commission has suggested and supported an increase of use of prunings as biomass fuel or through composting, these specific uses are still marginal either due to technical limitations or legislative issues, and low remuneration of the reuse chain, and currently most of the pruning residues are still outside of the bioenergy supply chain. In fact, although forestry and milling wastes are commonly used for producing pellet and woodchip, pruning residues have more limited use potentials due to their variable and composite quality, as compared to other plant biomass. The lack of systematic re-use of pruning residues and their remaining outside from the bioenergy market, rise sustainability concerns. There is currently no suitable large-scale value chain for pruning residues across EU, which are commonly managed across multiple collection sites at local scale, mainly composted or landfilled. There is also uncertainty on the amount of pruning residues actually used to produce energy in EU Member States, because the current EUROSTAT (2014) category 'other vegetal materials and residues', includes biomass not specified elsewhere, including pruning residues from orchards, private and public green areas and prunings from environmental maintenance operations.

Efforts in all EU countries have been made to assess the physico-chemical properties of wood residues to describe the pruning material as potential biomass for energy production or other industrial uses, whereas alternative uses, particularly aiming at green waste reuse in agriculture, are still poorly developed. The main biological treatment for reuse wood pruning in agriculture is their composting followed by mechanical fractionation to obtain an homogeneous green material to be used as soil amendment or for other admitted uses such as landfill cover and revegetation. Pruning waste composting performed in Europe is currently quite primitive, as they are mainly collected and piled in authorized composting plants, without specific treatments or devised end uses. The rationale of the AGRISED project is to demonstrate that a properly designed co-composting process for producing innovative soil amendments and plant growing media for professional uses, can bring

short-distance local value chains, even for large-scale production volumes and long-distance (e.g. 250 km) transportation. In fact, while generally pruning residues are produced on relatively small scale and dispersed sites, by taking advantage of existing collection and treatment sites, it is possible to achieve a sustainable, valorization and beneficial reuse of pruning residues (Figure X), inducing also bioeconomy development of rural areas. The latter aspect is a pillar of the European Agricultural Fund for Rural Development (EAFRD), which also shares knowledge transfer, training and skills acquisition by all the actors of the agricultural production, but also crosslinks and promotes cooperation with other industrial sectors, waste management in the case of AGRISED. The devised sediment and pruning waste reclamation and valorization activities also take into account the issues of climate and renewable energy and biomass sustainability at European level for the upcoming 2030 targets, and fulfill the bioeconomy cascade principles, to ensure that maximum value is extracted from both waste materials, the dredged sediment and the pruning residues, also valorizing low quality biomass for energy production.

4.1 The European legislation on management of pruning residues

Italy, where the AGRISED demonstration trials will be conducted is among the EU Countries producing the highest amounts of pruning residues with an average annual production of 6 million tons per year. It is estimated that in Mediterranean Countries, pruning from orchards produce more than 2.5 tons of pruning residues per ha per year. Although there is clear figures about the impact caused by lack of management of pruning residues in the EU, their re-use is in line with the need of increase renewable energy to meet the 2020 climate and energy targets. Notwithstanding the most recent EU Directives 2015/1185 and Regulation 2015/1189 (Directive 2009/125/EC) also encourage the use of pruning residues for energy producing. Also, at European level, the DIRECTIVE 2008/98/EC of the European parliament and of the council excluded straw and pruning from the waste directive (chapter 1, art. 2).

According to the art. 185 of LG.D. n. 152/2006 modified by art. 41 L n. 154/2016 the straw and pruning residues are not considered wastes, nor by products ruled by the arts 183 and 184 of the LG.D. n. 152/2006, and they can be used directly without specific permits. Because the pruning residues that will be used for the AGRISED sediment co-composting process are not of agricultural origin, are not used as such in agriculture, and are not dangerous for human health and do not impact the atmosphere and the surrounding environment as demonstrated by the pilot experiments (Mattei et al., 2016, 2017), they can be used for the proposed activities without the necessity of specific permits. This is also supported by a specific clarification note n. 141 of July 08 2015 of the

Tuscany Environmental Protection Agency (ARPAT). In Tuscany, where the AGRISED demonstration trials take place, the above mentioned activities are in compliance with the mowing activities regulated by the Tuscany Regional Law n. 79/2012. Moreover, the deliberation of n. 269 of 05 April 2016 of the Tuscany Region Council on the operating criteria for the activity of ordinary maintenance of river basins, regulate the grass mowing and management in the river bed, shores and the embankments, stating that plant residues must not be left over in the environment or burned, as prescribed by the EU Nature 2000 Directive and local reference norms (e.g. art. the 2, Regional law 30/2015). While burning may have some positive effect when used as firewood for self-consumption, or on soil fertility when it is burned on site, it can have also negative effects on the crop cultivation (e.g. it can act as vector for plant disease), and also does not allow biomass valorization.

Table 3. Main European and Italian regulation on straw and pruning

DIRECTIVE 2008/98/EC of the European parliament and of the council (19 November 2008) on waste. exclusion of straw and pruning from waste directive. "The following shall be excluded from the scope of this directive: f) fecal matter, if not covered by paragraph 2(b), straw and other natural non-hazardous agricultural or forestry material used in farming, forestry or for the production of energy from such biomass through processes or methods which do not harm the environment or endanger human health"
LG. D n. 152/2006 **art. 185** straw and pruning residues are not considered wastes, nor by products ruled by the arts 183 and 184 of the D.Lgs n. 152/2006, and they can be used directly without specific permits
L 154/2016 Delegations to the Government and further provisions on the simplification, rationalization and competitiveness of the agricultural and agri-food sectors, as well as sanctions on illegal fishing. Art. 41 (modification of art. 185 LG. D n. 152/2006) regarding exclusion from management some waste Letter f) of paragraph 1 art. 185 LG. D n. 152/2006 is replaced by the following: '(F) faecal matters, if not included in the subparagraph 2, letter b) of this article, straw, mowing and pruning from the activities referred to in Article 184, paragraph 2, letter e), and paragraph 3, letter a), **and** any other non-dangerous natural agricultural or forestry material intended for normal agricultural and animal practices or used in agriculture, forestry or for the energy production from this biomass, even outside of the place of production or with transfer to third parties, through processes or methods that do not damage the environment nor human health'.

In the Czech Republic, the most common waste disposal is landfilling, regulated by Decree the 294/2005 Coll., on conditions of waste landfilling and their use on ground surface, and amending Decree no. 383/2001 Coll. (Ministerstvo Zivotniho Prostredi, 2014, https://www.mzp.cz/C1257458002F0DC7/cz/plan_odpadoveho_hospodarstvi_aj/$FILE/OODP-WMP_CZ_translation-20151008.pdf). The landfilling of untreated waste, with the exception of inert waste and waste for which volume reduction elimination of hazardous substances or treatment is technically unfeasible, is prohibited. In the Czech Republic, data on green waste are provided along with those on bio-waste, and is among the major future environmental issues.

The European Environmental Agency (EEA, 2011, (http://ec.europa.eu/environment/waste/framework/pdf/CZ%20factsheet_FINAL.pdf) reported that

in the Czech Republic 239 composting plants, 52 community composting facilities, 326 biogas power plant stations and 10 biogas waste stations existed. This capacity is still not sufficient to prevent green waste landfilling sufficient and other strategies should be adopted to meet the recycling targets for 2020, and composting activities were those chiefly suggested by the main Country waste organizations to prevent problems with illegal dumping of green garden and other bio-wastes in rural areas.

5. Bioremediation and reuse of dredged sediments

5.1. Current technologies for bioremediation and reuse of dredged sediments

Currently, the most practiced and sustainable bioremediation technology for the reclamation of dredged sediments of various origins is the biopile coupled to landfarming. This approach allows the degradation of the organic contaminants and homogenizing the treated sediments. Generally, the biopile treatment follows a particle size mechanical fractionation to separate boulders (> 256 mm), cobbles (256-64 mm) and gravel (64-2 mm), that generally can be immediately reused in various industrial processes. The coarse sand (2-0.5 mm), medium sand (0.5-0.25 mm), fine sand (0.25-0.062 mm), silt (0.062-0.002 mm) and clayey (< 0.002 mm) fractions are then subjected to biopile remediation. These fractions are those that can be valorized in agriculture because they present high concentrations of nutrients such as C, N, P, S, K, Mg, and Ca, and high specific surface suitable for positive interactions with the plant roots. The preliminary texture selection induce a concentration effect of nutrients but also the concentration of inorganic and organic pollutants, potentially present in the initial sediment, because both nutrients and contaminants are adsorbed onto their reactive surfaces of the clayey fraction or trapped into the smaller organic mineral aggregates. In fact, sediments represent a natural sink for pollutants of various origins, especially those dredged from urban and industrialized areas. Main contaminants normally present in river sediments are aliphatic and mono-aromatic hydrocarbons, polycyclic aromatic hydrocarbons (PAHs), mono and plychlorinated hydrocarbons (PCB), organo-metallic compounds (e.g. organo-Sn compounds), organic-chlorinated agrochemicals leached from the agricultural soils, active ingredients of drugs and personal care products. The organic contaminants are generally associated to inorganic ones such as metals and metalloids (e.g. As, Be, Cd, Cr, Cu, Hg, Ni, Pb, Se, Sn, V e Zn), alloys and asbestos. The contaminants also partition depending on their water solubility, and the metallic elements can undergo to red-ox reactions with other compounds such as sulfides and phosphates forming new mineral phases, whereas elements such as As, Hg, Se can undergo to biologically driven reductive reactions (e.g. methylation) forming new organo-mineral complexes or volatilize.

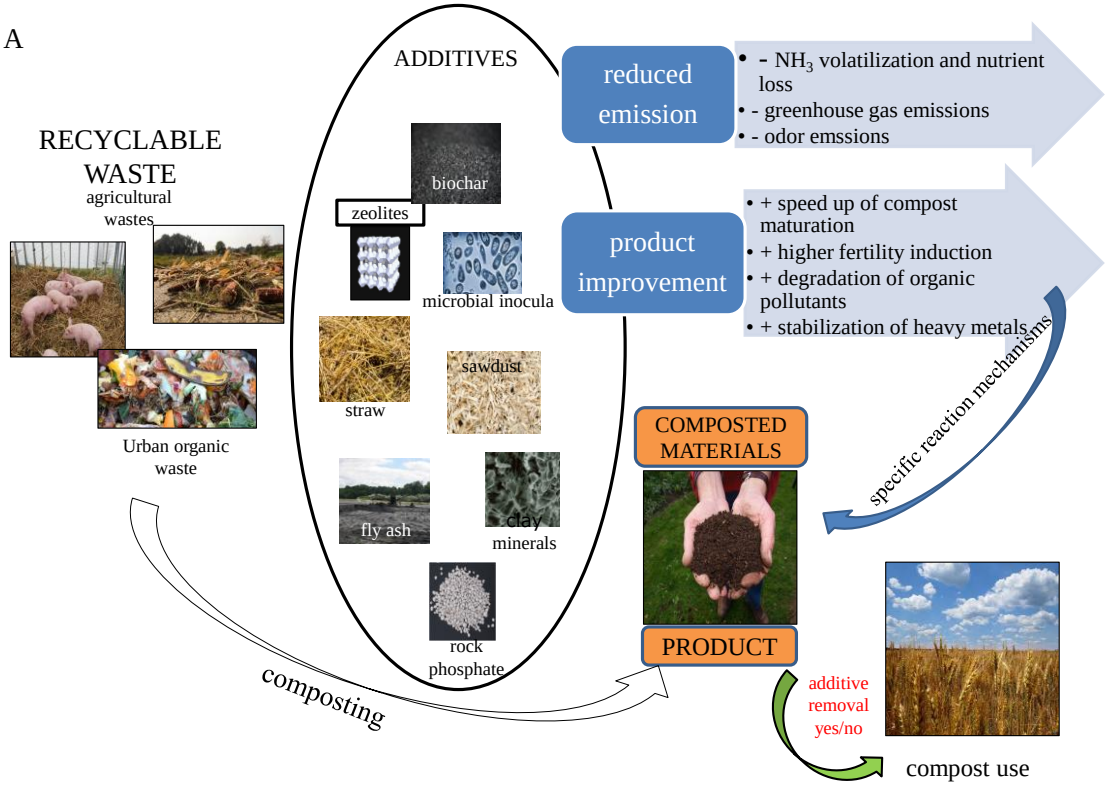
The biopile-landfarming approach, though its great potential for sediment remediation and reclamation, generally leads to a reduction reduce of the nutrient content of the final product due to leaching and volatilization of C and N caused by the microbiological activity and provide a final product with a narrow range of physical, chemical and microbiological properties, which can limit the potential utilization of the final product, particularly in agriculture. Another limiting aspect of the biopile technology is the relatively low temperatures reached by the process, resulting in a poor sanitation of the final product. In fact, in the absence of specific forced air circulation machineries

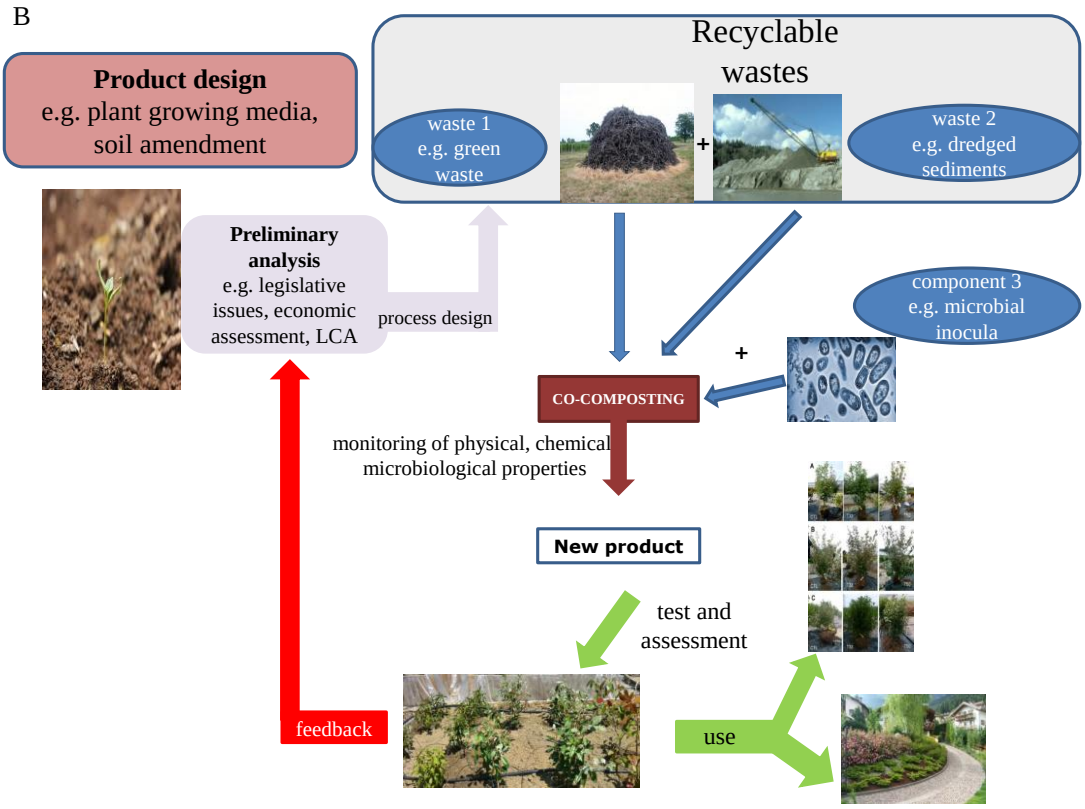
and inoculation of external microorganisms or organic matter the temperature reached during the degradation of the organic matter seldom reach 50 °C, which is insufficient to destroy most of the human pathogens present in the original sediments, particularly those forming spores.

5.2 Innovative co-composting technology for reclamation and reuse of dredged sediments

Recently, Giagnoni et al. (2019), defined the co-composting as a designed technique that allows the aerobic degradation of organic waste mixtures, primarily aiming at obtaining a product with specific characteristics. As compared to the typical composting activity, the main difference is that the waste admixture not merely constituted to initiate and sustain the biodegradation process, but also the possibility of combine various wastes to obtain 'tailored' products with designed properties, or to reclaim and valorize natural resources such as degraded soils or polluted soils and sediments (Figure 3), through the set up of appropriate co-composting protocols. The AGRISED project aims at demonstrate at farm scale the potential of co-composting of dredged sediment and green waste for the creation of novel plant growing media for professional plant nursery and novel amendments for the restoration of degraded soils.

Figure 3. Illustration of the differences between the classical (A) composting and co-composting process (B) from product design to product evaluation and use. Modified by Giagnoni et al 2019





In a pilot experiment conducted at the University of Florence, Mattei et al. (2017, 2018) showed co-composting of sediments dredged and bulked from the Navicelli canal with shredded green residues obtained by the pruning of private and public areas, could be a feasible technology for producing innovative soil amendments and professional growing media for the plant nursery industry (Figure 4).

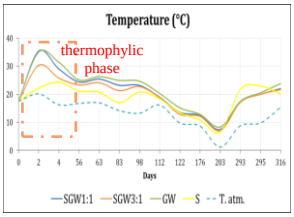
Figure 4. The pilot sediment-green waste co-composting experiments carried out by the Beneficiary UniFi in the years 2010-2013. A) Composters and physico-chemical properties of the produced sediment-based growing media; B) photinia and viburn plants grown on the various sediment-based growing media compared to the same plants grown on a commercial peat-based growing media. Photo credit Dr. Paola Mattei, University of Florence.

A

Dredged sediments

mix

co-composting



Pruning residues

Growing media produced

Physico-chemical parameters	S:GW 1:1	S:GW 3:1	Pruning residues	Sediments
Bulk density	0.41^{c}	0.65^{b}	0.19^{d}	1.04^{a}
pH value	8.02	8.20	8.20	8.02
EC value (mS cm^{-1})	2.92^{b}	4.25^{a}	0.88^{c}	4.98^{a}
TOC%	13.6^{b}	5.52^{c}	32.30^{a}	1.75^{d}
N%	0.42	0.25	1.15	0.17
C/N	32.0^{a}	22.1^{b}	28.6^{b}	10.0^{c}
Humic substances (total)	6588^{b}	4651^{c}	22191^{a}	1731^{c}
Humification index	H3-H6	H3-H6	H3-H6	H3-H6
PAH total (mg kg^{-1})	0.5^{b}	0.5^{b}	0.05^{c}	0.9^{a}
Phytoxicity	<20%	<20%	<20%	<20%
Microcrustacean toxicity	<20%	<20%	<20%	<20%
Biotox	<20%	<20%	<20%	<20%

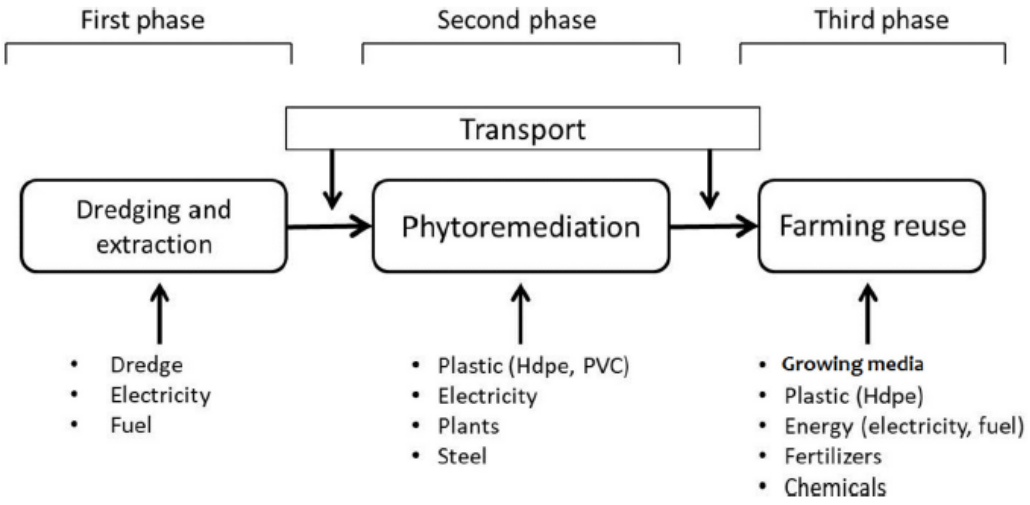
B

	Plant elongation (cm)				
	S:GW 1:1	S:GW 3:1	Green waste	Sediments	Peat
Viburnum tinus	3.0^{a}	4.9^{a}	5.3^{a}	1.5^{b}	1.62^{b}
Photinia x fraseri	13.5^{a}	9.2^{b}	17.0^{a}	6.3^{c}	8.0^{b}
	Plant biomass (g)				
Viburnum tinus	5.3^{b}	7.0^{a}	8.4^{a}	2.3^{c}	6.5^{b}
Photinia x fraseri	8.7^{b}	9.7^{b}	9.0^{b}	7.9^{c}	11.9^{a}

In a following study, Mattei et al. (2018) demonstrated that replacement of peat by remediated sediments resulted in an overall decrease of C footprint assessed by Life Cycle Analysis (LCA) of plants grown on sediment-based as compared to plants produced on peat-based growing media from 10 to 26%, mainly due to lower use of water and fertilizers. The same study also showed that growing plants on reclaimed sediments also reduced the incidence of the growing media on the overall GWP per produced plant from 22% for peat-based growing media to 4% (Figure 5).

Figure 5. The LCA analysis framework (A) and global warming potential (GWP) values expressed as carbon dioxide equivalents (CO_2 eq.) of red robin photinia plants produced on sediment-based growing compared to the same plants produced on peat-based growing media (B). The picture (B) also report the GWP Variation indicating the percentage of reduction of CO_2 eq. as compared to the plants grown on the different growing media. Values of the 'Incidence' column indicate the relative contribution of growing media to the CO_2 eq. for the plants grown on the different growing media. Symbols S, S+PR. S+F and C indicate the sediment, sediment plus pruning residues, sediment plus fertilizer and peat-based growing media. respectively.

A



B

Growing media	GWP (Kg CO_2 eq.)			
	Per plant	Growing media	Variation (%)	Incidence (%)
S	0.232	0.02	−25.7	9
S + PR	0.282	0.01	−9.6	4
S + F	0.236	0.02	−24.4	8
C	0.312	0.07	–	22

6. AGRISED strategy for overcoming current legislative limitations and technical reasons for hindrance

The AGRISED project, in the perspective of circular economy, will seek for a sediment reuse as defined by the United States Corp of Engineers (USACE) as '*all productive and positive uses of dredged material such as: habitat development, beach nourishment, parks and recreation, strip mine reclamation, agriculture, forestry, horticulture etc…*'. This means that sediments should not only undergo to remediation actions to reduce their pollutants load and toxicity to humans and ecosystems, but also to *ad hoc* valorization treatments and processes for producing new materials with economical value and a potential market. Among the most promising uses of reclaimed dredged sediments, the previous LIFE projects CLEANSED and HORTISED demonstrated the great potential use of reclaimed sediments as soil amendments and plant growth media for the plant nursery industry.

Plant growth and crop production depends on soil fertility, which can be defined as the capacity of soils to support the plant growth and supply the crops with nutrients. In climax natural ecosystems, the plant community is in nutritional equilibrium with the soil fertility. On the contrary, in the agroecosystems the complete or partial removal of the crop production from the farm soil produce imbalance in the nutrient budget of the soil. Therefore, in intensive cropping systems, the soil nutrients level is generally insufficient to ensure the maximum crop production either quantitatively or qualitatively. Just as few examples, nitrogen is the main nutrient stimulating the optimal plant growth, availability of P, K Mg and Cl is important for the strength of plant support structures and several key physiological cellular mechanisms. Plant nursery is among the most intensive agricultural activities, particularly for ornamental plants grown in pots, and limiting nutrient availability cause severe stunted growth. The initial fertility of the traditional peat- and coir pith based growing media is generally low and optimal plant growth requires high fertilization rates. This causes an increase of the economic production costs and high environmental impact of the plant nursery productions. Another important aspect is the high demand of water supply of the peat- and coir pith based growing media due to their low water holding capacity, related to their poor structure unless gravel or pumice is added to the mixture. This poor physical fertility also cause the growing media degradation after one cultivation cycle, which is another major drawback of the traditional commercially available professional plant growth media.

Materials used as plant growing media in Europe include: white and lack peat, used in all horticultural segments, coir pith obtained by mechanical processing of coconuts husks, bark, particularly used in floriculture. These main organic materials are generally mixed with other

organic materials such as green compost, wood fibers and rice hulls, and inorganic materials such as clay, perlite, pumice sand and gravel to achieve optimal physical and chemical properties, particularly in relation to growing media shrinking and swelling, water retention, nutrient adsorption and availability to plants. Therefore, it can be concluded that professional growing media are mixes of organic and inorganic materials ensuring the optimal plant growth and health. All of the most used professional plant growing media used in Italy and Czech Republic consist of the materials supplied from long distance. For instance, the main peat suppliers for the Italian industry are located in the Baltic Countries, mainly Lithuania, whereas the coir pith is obtained from coconut plantation located in the South-West Asia, mainly Sri-Lanka, India and Philippines. Concerning the inorganic bulking materials, they are also materials with a high C footprint, because they are excavated (pumice) or produced using high energy input technologies (perlite).

Sediments accumulate organic compounds rich in nutrients, primarily N and P, either resulting from the degradation of biological molecules such as proteins, lipids, sugars and, nucleic acids, or molecules newly formed by the activity of endogenous microorganisms. Carbon, N, P, S, K, Na, Ca, Mg and Cl are the main nutrients (macronutrients) required for the growth of living organisms, along with a large number of elements such as Fe, Mn, Cu, Ni, Se, and Zn termed micronutrients, essential for the optimal functioning of several key enzymes of microorganisms, animals, and plants. Differently from the animals and other heterotrophic organisms, plants take up all nutrients from soil and growing media in their mineral forms, except C fixed by the photosynthesis.

The AGRISED project will demonstrate the potential of the co-composting process of dredged sediments with green waste for producing growing media for the plant nursery industry and raw materials for the creation of manufactured topsoils for environmental remediation. The use of sediment-based topsoil, besides constituting a sustainable use of a waste material (dredged sediments), could lead to replace, at least in part, unsuitable and non-renewable raw materials traditionally used, such as quarry materials, pumice and peat, whose extraction involves considerable environmental and economic impacts. It is also noteworthy to mention that the reuse of sediments in agriculture can also represent a mitigation of the erosive phenomena related to intensive agriculture, as it could contribute to ‘close’ the natural sediment cycle (Figure 4).

In Italy, the joint provisions of the Legislative Decree 152/2006 and Presidential Decree n°120/2017 allow non contaminated sediment reuse for several uses in civil engineering as inert materials, e.g. as filling materials for motorway guardrails, brick production and cement industry, landfill cover and liners. Analogously, the green waste produced from the pruning and maintenance of private and public green areas are considered as ‘related’ agricultural activity (art. 2135 c.c.;

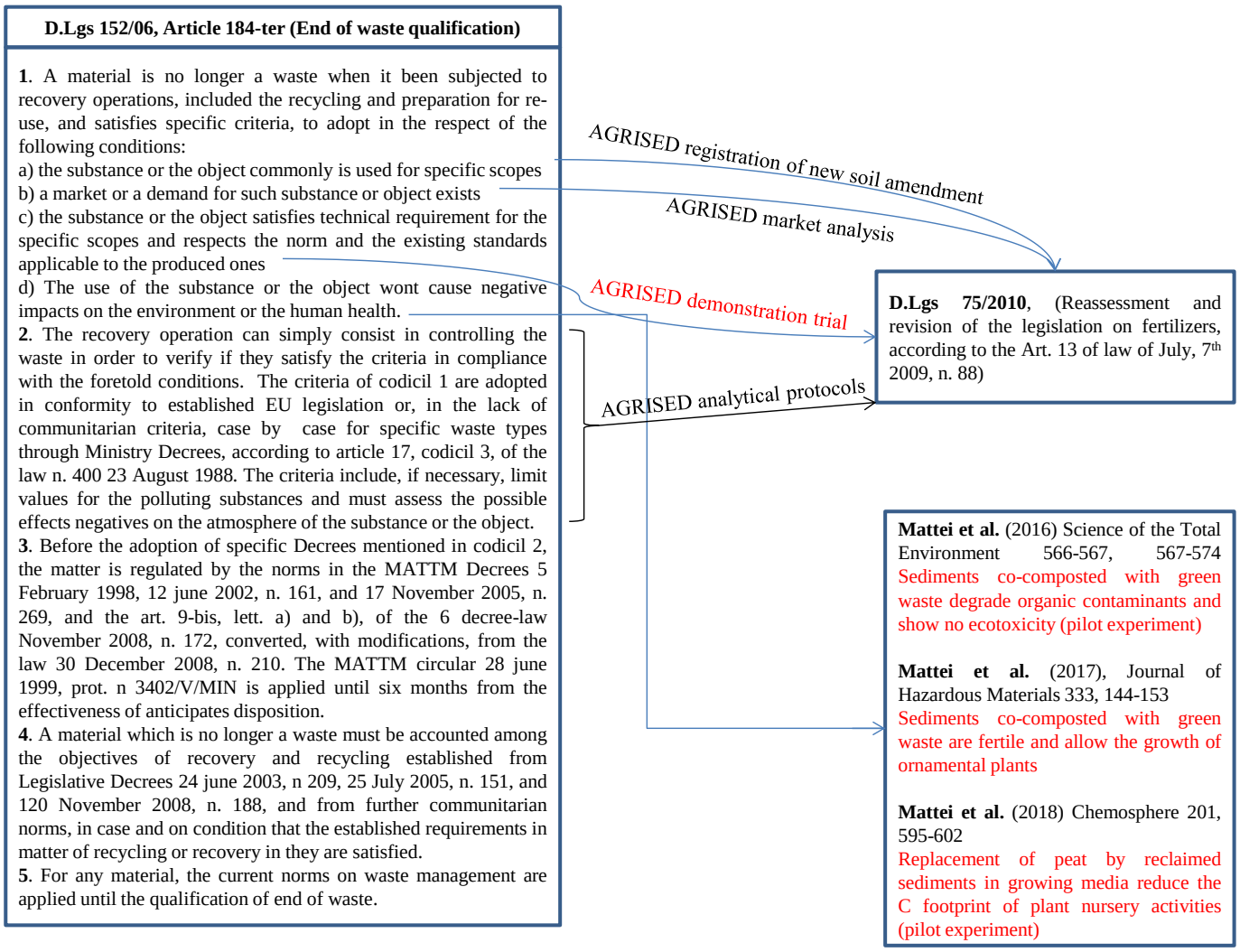
D.Lgs. 99/04), and the produced green residues are classified as waste (M.A.T.T.M. 11338/2011, 6038/RIN/2015). However, the part IV, Art. 214, c.7 bis allows the composting of green waste after the authorization (V.I.A., A.I.A.) by the Regional Authority and by the local Regional Agency for Environmental Protection (ARPA) and formulation of stringent code of conduct and designation of a process responsible manager. Green residue burning is also allowed by the Italian environmental legislation, but it can be practiced only upon authorization by the local Regional and Communal authorities and is forbidden in selected periods of the year.

The AGRISED project will remove the current main reasons for hindrance in the reuse of reclaimed sediments as soil amendment and growth media for the production of ornamental plants by bridging the two main environmental and agricultural legislations in the way shown in Figure X. Among the current problems that can limit the 'end of waste' qualification for sediments and their reuse in agriculture there is the fulfilling of the letter 'c' of the D.Lgs 152/06, Article 184-ter that states '*the substance or the object satisfies technical requirement for the specific scopes and respects the norm and the existing standards applicable to the produced ones*' (Figure 6). In fact, while there is no problems in fulfilling the other legislative items, according to such codicil, to achieve an 'end of waste' qualification aiming at the reuse of dredged materials in agriculture as growing media or soil amendments the physical, implies that such materials are fully compatible with the 'standard' materials currently used in agriculture. This means that the use of reclamation technologies *per se* is not sufficient to achieve a status for sediment reuse in agriculture, because properties of any material to be used in agriculture must be referred to materials currently listed in the Attachment 2 of the D.Lgs 75/2010.

The main legislation regulating the professional use of growing media and soil amendments in Italy is the Legislative Decree 75/2010. This norm shares all the conditions and requisites, and also lists all the materials of the inorganic and organic fertilizers, amendments and growing media that can be officially used in agriculture. Currently, while composted green waste can be used as soil amendment, soil conditioner or growing media if it meets the physico-chemical and microbiological properties, sediments are currently not admitted. Currently, the use of sediments as soil amendments or growing media is not admitted (see attachment 2). Inclusion of any new fertilizer or soil amendment in the list of the Legislative Decree 75/2010 requires a registration of the producer company, with full commercial details, and the specification of the physico-chemical and microbiological properties of the new materials. The producer company must specify the material classification, the method of preparation and the main components, the concentration of macro- and micronutrients, the hygienic parameters and eventual other specific characteristics of the new

materials. Soil amendments and growing media are included in the attachments 2 and 4 of the Legislative Decree 75/2010, respectively (Figure 7). It is also necessary to indicate the estimated annual amount of materials produced, the production process, the raw materials, the analytical methods used for the characterization of the final product and the variability range, the health risk assessment, including the REACH specifications, the environmental risk assessment and the agronomic efficacy of the new product (Figure 7).

Figure 6. The article of the Italian environmental legislation (D.Lgs 152/06, Art. 184-ter) regulating the end of waste, the compliance of the AGRISED activities (blue arrows) and the links (red arrow) created by the AGRISED project with the Italian legislation (D.Lgs 75/2010) sharing the list of fertilizers, soil amendments and growing media allowed to be used in agriculture. Citations in the lower box indicate the compliance of the envisaged activities with the rest of the Art. 184-ter as supported by the previous scientific research carried out by the UniFi beneficiary.

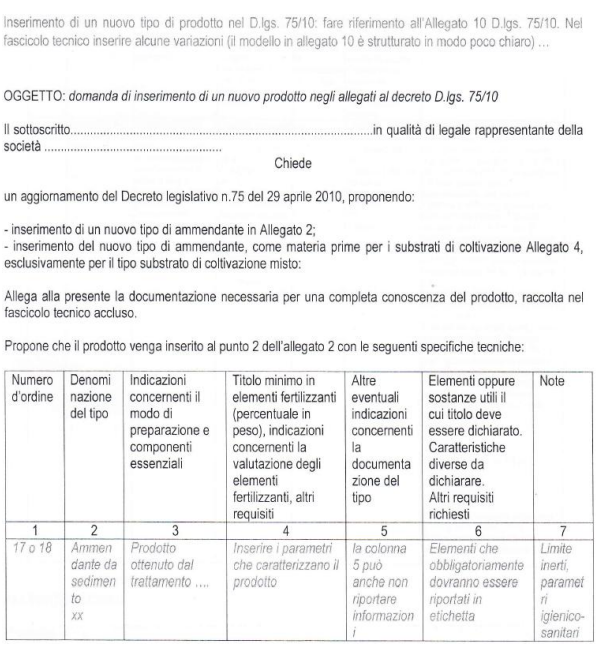


The composting activities will be conducted in compliance with the Legislative Decree 4/08, in the ambit of the Art 3-quarter, stating the principles of sustainable development.

The AGRISED project will demonstrate that innovative plant growth media and soil amendments created by the co-composting of dredged sediments and green waste have an initial higher physical, chemical and biological fertility that ensure a better plant growth with lower use of chemical fertilizers and irrigation water, and the potential reuse of the same growth media for several plant cultivation cycles. These important features resulted from the results of the pilot experiments carried out by Mattei et al. (2017, 2018) and other greenhouse experiments, as well as from the from previous demonstration trials carried out in the ambit of the LIFE CLEANSED (LIFE/12/ENV/IT000652) and HORTISED (LIFE/14/ENV/IT000113) projects. Classically, the efficacy of any fertilizer or soil amendment is defined as the ratio between the plant production with the standard practice and the yield increment using the new materials, according to the following formula: $E = [(C_N-C)]/N$, where C_N is the yield of plant on the new media, C is the plant yield on the traditional media, N is the amount of media used. For ornamental plant production other factors must be considered, particularly the sustainability of the plant production and the plant grade, production costs. All these factors will be evaluated during the AGRISED project and the results will be used to fulfill some of the main technical requirements for the inclusion of sediment-based growing media among the officially admitted soil amendment and professional plant growing media.

In addition to the legislative norms on raw materials, physical, chemical and microbiological properties, recommended uses, there is additional lists of parameters for quality grading of soil amendments and growing media established by International and National growing media producer associations. Although such qualitative parameters are not mandatory, they represent important technical requisites that stem from decades of work experience of the practitioners in the different fields of plant nursery industry. Therefore, for the general aims of the AGRSED project to produce ready to market novel sediment-based growing media, an evaluation of their characteristics against the parameters generally considered by the potential end users will be conducted. Comprehensive lists of qualitative parameters have been prepared at European level by the European Peat and Growing Media Association (EPAGMA), and in Italy by the Associazione Italiana Produttori di Substrati e Ammendanti (AIPSA).

Figure 7. Template of file to be filled for the request of registration of new fertilizers and soil amendments in the attachments of the D.Lgs 75/2010, and the link with the AGRISED proposed registration of the novel sediment-based growing media and soil amendment.



Inserimento di un nuovo tipo di prodotto nel D.lgs. 75/10: fare riferimento all'Allegato 10 D.lgs. 75/10. Nel fascicolo tecnico inserire alcune variazioni (il modello in allegato 10 è strutturato in modo poco chiaro) …

OGGETTO: *domanda di inserimento di un nuovo prodotto negli allegati al decreto D.lgs. 75/10*

Il sottoscritto.....in qualità di legale rappresentante della società .....

Chiede

un aggiornamento del Decreto legislativo n.75 del 29 aprile 2010, proponendo:

- inserimento di un nuovo tipo di ammendante in Allegato 2;
- inserimento del nuovo tipo di ammendante, come materia prime per i substrati di coltivazione Allegato 4, esclusivamente per il tipo substrato di coltivazione misto:

Allega alla presente la documentazione necessaria per una completa conoscenza del prodotto, raccolta nel fascicolo tecnico accluso.

Propone che il prodotto venga inserito al punto 2 dell'allegato 2 con le seguenti specifiche tecniche:

Numero d'ordine	Denominazione del tipo	Indicazioni concernenti il modo di preparazione e componenti essenziali	Titolo minimo in elementi fertilizzanti (percentuale in peso), indicazioni concernenti la valutazione degli elementi fertilizzanti, altri requisiti	Altre eventuali indicazioni concernenti la documentazione del tipo	Elementi oppure sostanze utili il cui titolo deve essere dichiarato. Caratteristiche diverse da dichiarare. Altri requisiti richiesti	Note
1	2	3	4	5	6	7
17 o 18	*Ammendante da sedimento xx*	*Prodotto ottenuto dal trattamento ….*	*Inserire i parametri che caratterizzano il prodotto*	*la colonna 5 può anche non riportare informazioni*	*Elementi che obbligatoriamente dovranno essere riportati in etichetta*	*Limite inerti, parametri igienico-sanitari*

N.	Denominazione del tipo	Modo di preparazione e componenti essenziali	Titolo minimo in elementi e/o sostanze utili. Criteri concernenti la valutazione. Altri requisiti richiesti	Altre indicazioni concernenti la denominazione del tipo	Elementi oppure sostanze utili il cui titolo deve essere dichiarato. Caratteristiche diverse da dichiarare. Altri requisiti richiesti	Note

13.	Ammendante compostato con funghi	Prodotto ottenuto attraverso un processo controllato di trasformazione e stabilizzazione di reflui e funghi nonché dalle matrici previste per l'ammendante compostato misto	Umidità: massimo 50%
			pH compreso tra 6 e 8,8
			C organico sul secco: minimo 20%
			C umico e fulvico sul secco: minimo 7%
			Azoto organico sul secco: almeno 80% dell'azoto totale
			C/N massimo 25.
				---	Umidità
					pH
					C organico sul secco
					C umico e fulvico sul secco
					Azoto organico sul secco
					C/N
					Salinità
						Per "funghi" di cui alla presente colonna e alla colonna n. 5 si intendono quelli di cui al Decreto legislativo 27 gennaio 1992, n. 99 e successive modifiche e integrazioni. I funghi, tranne quelli agroindustriali, non possono superare il 55% (p/p sostanza secca) della miscela iniziale. I funghi utilizzati per la produzione di dell'Ammendante compostato con funghi, nelle more della revisione del D.Lgs. 99/92, devono rispettare i seguenti limiti: PCB = 0,8 mg/kg s.t.;
						È consentito dichiarare i titoli in altre forme di azoto, fosforo totale e potassio totale.
						Il tenore dei materiali plastici vetro e metalli (frazione di diametro ≥2 mm) non può superare lo 0,5% s.s.
						Inerti litoidi (frazione di diametro ≥5 mm) non può superare il 5% s.s.
						Sono inoltre fissati i seguenti parametri di natura biologica.
						- Salmonella: assenza in 25 g di campione t.q.;
						n(1)=5; c(2)=0;
						m(3)=0;
						M(4)=0;
						- Escherichia coli: in 1 g di campione t.q.;
						n(1)=5; c(2)=1;
						m(3)=1000 CFU/g;
						M(4)=5000 CFU/g;
						Indice di germinazione (diluizione al 30%) deve essere ≥60%
						-Tallio: meno di 2 mg kg-1 sul secco (solo per Ammendanti con sigla:

Technical file to be included for the registration of new soil amendments and growing media in Italy, as annex 2 of the D.Lgs 75/2010

Descrizione del produttore e quantità prodotte

Riportare la descrizione dell'attività dell'azienda produttrice. Dare indicazioni sulla quantità di prodotto che verrà resa disponibile e lo scopo per il quale viene presentata l'istanza.

Processo di produzione

Descrivere in dettaglio il processo di produzione. Riportare i criteri di tracciabilità adottati.

Materie prime

Descrizione delle caratteristiche e origine.

Composizione del prodotto finito (parametri caratterizzanti, metodo di analisi e tolleranza)

Inserire i parametri caratterizzanti il prodotto (forma e concentrazioni). Indicare i limiti di inquinanti (considerando che il prodotto deve rispettare il limite di metalli pesanti previsti per tutta la categoria degli ammendanti). Indicare per ogni parametro il metodo di analisi e la tolleranza. Utilizzare metodiche ufficiali (metodi ufficiali fertilizzanti, oppure EN, ISO, ecc…), diversamente dovrà essere fornito il metodo analitico, con la procedura (però in questo caso, nell'iter di valutazione si dovrà inserire anche la valutazione del metodo).

Salute e sicurezza

Inserire dati che evidenziano con dati oggettivi la valutazione oggettiva, la tossicità nei confronti della salute umana, animale e dell'ambiente.

Inserire la valutazione dei parametri igienico-sanitari (E.Coli, Salmonelle).

Posizione REACH

Aspetti ambientali

Se del caso, andranno essere inserite raccomandazioni per la tutela ambientale, eventuali consigli sull'uso del prodotto, indicazioni rispetto a particolari condizioni pedoclimatiche o di interferenza con altri formulati o pratiche agricole.

Efficacia agronomica

Relazione tecnico scientifica sull'efficacia agronomica del prodotto. Inserire bibliografia scientifica a supporto dei dati inseriti.

Considerare separatamente i due utilizzi proposti: prodotto ammendante da pieno campo e materia prima per i substrati

Details of the producing Company and amounts of materials produced: a full description of the potential annual production and the use will be provided at the end of the AGRISED project

Production process: co-composting of dredged sediments and green waste

Raw materials: dredged sediments (CER 17.05.06), green pruning waste (C.E.R. 20.0.201)

Composition of the final product: the novel sediment-based amendments and growing media will have basic parameters and variability range comparable to that of other amendments

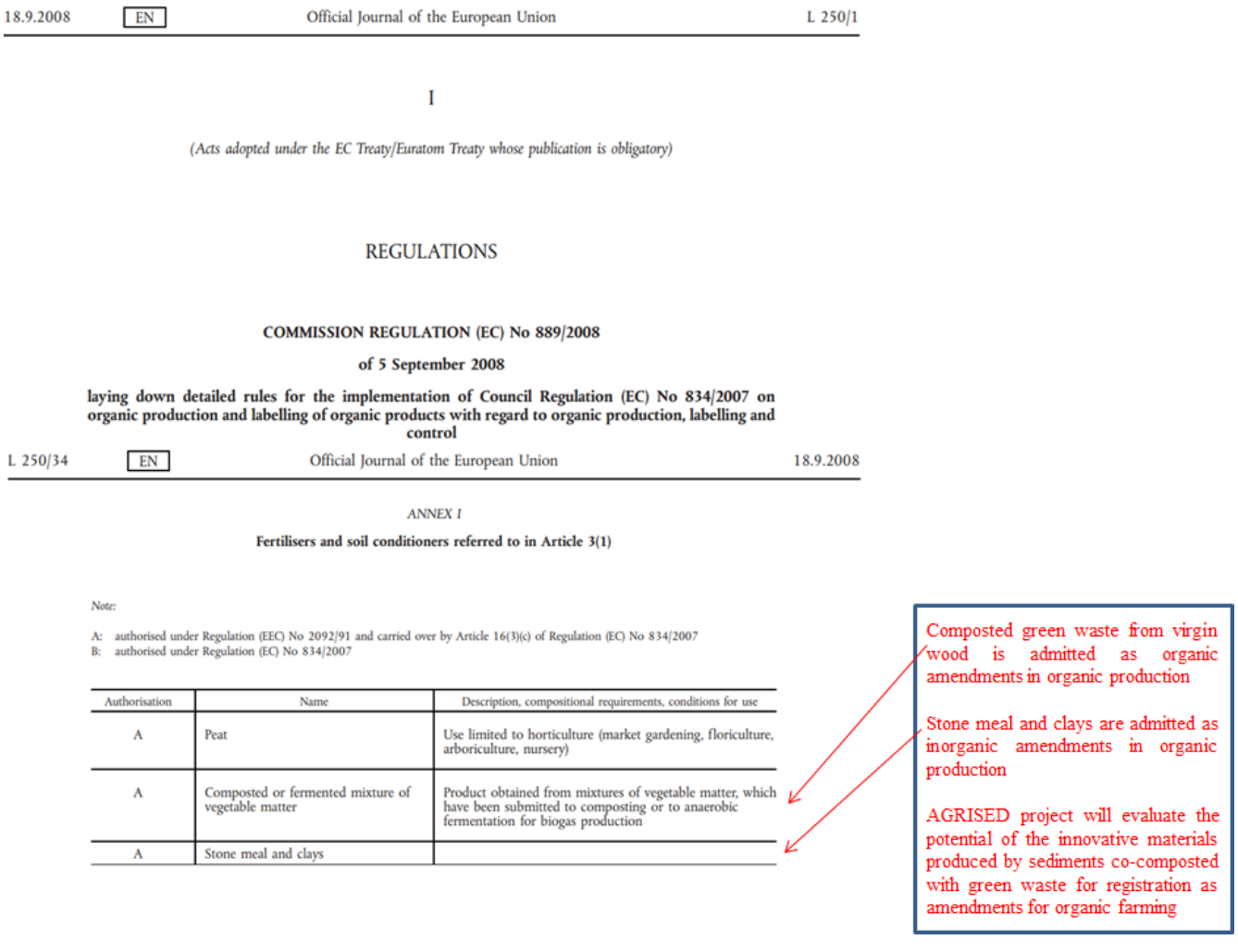
Health safety measures: risk assessment, hygienic data and REACH code will be defined at the end of the AGRISED project

Environmental aspects: Specific indications on the pedo-climatic and agronomic use of the novel products will be will be defined at the end of the AGRISED project

Agronomic efficacy: the AGRISED project will assess the agronomic efficacy of the novel sediment-based growing media and soil amendments by direct comparison with the currently used materials

Once the novel soil amendments and growing media will be obtained, they will be also evaluated in the light of their potential use in organic farming. Organic farming is a low input agricultural practice aiming at reducing the environmental footprint of primary productions, mainly by reduced tillage and no use of agrochemicals. In last decades, the WU market of organic products is slowly but steadily increasing, but there are still few consumer labels, e.g. the EU Ecolabel, EKO, Nordic Ecolabel, Blaue Engel, Milieukeur, Bioflora, to distinguish the products of sustainable plant nursery activities. In terms of fertilizers and amendments, the organic agriculture at EU level is regulated by the Regulation EC 889/2008, then modified by the Regulation EC 392/2013, that in Italy was received by the Ministry Decree DM 18354/2009 that lists in the Annex I the fertilizers, amendments and chemicals that can be used in Italy for organic farming. The Annex I has later been merged with the Annexes of the more general D.Lgs 75/2010. By considering the EU regulation, some of the soil amendments admitted for organic farming of specific interest of the AGRISED project are reported in Figure 8.

Figure 8. Amendments admitted in organic farming that may constitute the reference materials for the registration of the novel sediment-based growing media and soil amendment.



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I

(Acts adopted under the EC Treaty/Euratom Treaty whose publication is obligatory)

REGULATIONS

COMMISSION REGULATION (EC) No 889/2008

of 5 September 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

L 250/34 EN Official Journal of the European Union 18.9.2008

ANNEX I

Fertilisers and soil conditioners referred to in Article 3(1)

Note:

A: authorised under Regulation (EEC) No 2092/91 and carried over by Article 16(3)(c) of Regulation (EC) No 834/2007
B: authorised under Regulation (EC) No 834/2007

Authorisation	Name	Description, compositional requirements, conditions for use
A	Peat	Use limited to horticulture (market gardening, floriculture, arboriculture, nursery)
A	Composted or fermented mixture of vegetable matter	Product obtained from mixtures of vegetable matter, which have been submitted to composting or to anaerobic fermentation for biogas production
A	Stone meal and clays	

Composted green waste from virgin wood is admitted as organic amendments in organic production

Stone meal and clays are admitted as inorganic amendments in organic production

AGRISED project will evaluate the potential of the innovative materials produced by sediments co-composted with green waste for registration as amendments for organic farming

The registration of the sediment-based soil amendments and growing media in the annex of the Italian D.Lgs 75/2010 should also take into account the implications of the Penal Code art. 452-bis (crime of environmental pollution) which carries a sentence from two to six years, fines from 10.000 to 100.000 EURO, to whom improperly cause a significant impairment of the quality of water or air, wide areas of soil or subsoil of an ecosystem, of the biodiversity, also agricultural, of flora and fauna. Aggravating circumstances are: pollution of protected areas, areas under landscape, environmental, historic, artistic, architectural archeological bonds, or damage of endangered animals or plants (v. art. 452-bis, last codicil), the event of the death or injury of people (except the case of illness of less than 20 days) as consequence of the crime (art. 452-ter). Reduction of penalty are shared in cases of negligence (art. 452-quinquies, codicil 1), and when negligence only causes environmental pollution danger (art. 452-quinquies, codicil 2).

7. Conclusions

The AGRISED project seeks for the creation and validation of novel growing media for the professional plant nursery sector by a controlled process of co-composting of dredged sediments and pruning waste in different proportions. The demonstration of the suitability of the innovative growing media and of the sustainability of devised co-composting processes of the AGRISED project will offer a potential to developing new local value chains for both sediment and pruning residues, by involvement of stakeholders and policy makers, along with the dealers, plant producers and other end users and actors such as waste Organizations, that might benefit from the product design process. In this perspective, the AGRISED consortium will present to the Regional Authorities and to all the stakeholder the economic analysis and resource assessments (LCA) to illustrate the potential environmental and economic benefits at regional scale from the sediment based soil amendment and plant growing media from the devised sediment-pruning residues co-composting process. The AGRISED activity is in line with the current trends of EU Common Agricultural Practice (CAP), and in particular it complies with the aspects of the Good Agricultural and Environmental Conditions (GAEC), as it fulfills the requirements for farmers to maintain good soil quality and preserve the soil organic matter levels through sustainable technologies. According the GAEC, farmers producing prunings, may meet the GAEC by using the new sediment-based amendments, which may in turn reduce the use of fertilizers, particularly in areas with degraded soils, which is the core mission of the European Commission Farm Advisory Services and the European Innovation Partnership on Agriculture (EIP-Agri).