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ZEFFIROS

Zero-waste energy-efficient agricultural communities in the GR- Republic of North Macedonia cross-border area

DELIVERABLE 3.4

Analysis on legislation & certification for use of compost in agriculture

Sub-Deliverable 3.4.1 – Greek legislation and certification process of compost

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Table of contents

1. Introduction

The present sub-deliverable has been produced to highlight the analysis on existing legislation, and provide guidance to other partners towards the necessary processes for acquiring certification for use of compost produced by the pilot units in agriculture in the cross-border region. Moreover, the report focuses on the analysis on existing regulation and provides guidance towards the implementation of necessary steps for the future certification of the compost produced by the two pilot units. An analytic review of existing certification standards is presented to retrieve existing standards, taking into consideration the input and output characteristics and operational conditions of the pilot units.

2. Interactions between bioeconomy, bioenergy and biofertilizers

Undoubtedly, humanity goes through the era of emphasizing on resource efficiency towards the effort for transformation of our economy from linear to circular. In this context, the "value" of waste is the central factor. Waste is more than useful; a valuable input in the circular process to minimize and rationally use materials, energy and water resources. Circularity is all about streams of excess or end-of-life materials, previously regarded as waste mainly origin from anthropogenic activities. These materials (organic or inorganic) are managed holistically, are associated to life cycle thinking considerations and target values and are channeled through a combination of available technologies and converted into useful energy carriers, nutrient-rich organic fertilizer and, in general, novel materials.

Bioeconomy, bioenergy and biofertilizer are strongly interrelated with the optimal treatment of biodegradable waste in the framework of a holistic management strategy. The term biodegradable waste mainly includes; (i) biodegradable fractions of municipal solid waste (MSW), (ii) commercial food waste, (iii) forestry residues, (iv) agricultural waste, (v) wastes from the food and beverage industry, and (vi) sewage sludge. Characteristic waste typologies can be found in the Waste Framework Directive. Biodegradable waste can be subjected to a set of treatment operations, mainly; (i) landfill, (ii) anaerobic digestion, (iii) thermal treatment (incineration, gasification, pyrolysis etc.), (iv) mechanical biological treatment, (v) mechanical biological stabilization, (vi) composting, and (vii) fermentation. In most real-world cases, a combination of these alternatives is put forward. The advantages and disadvantages of available technical solutions should be under investigation to efficiently support the appropriate combination of treatment initiatives. The type of biodegradable waste, local characteristics and conditions should be considered (Vea et al., 2018; Delgado et al., 2020).

The optimal combination of treatment operations constitutes a significant challenge that reinforces environmental sustainability by minimizing impacts, especially related to uncontrolled discard. A biodegradable waste management strategy includes biological treatment. Although different forms of biological treatment are available, anaerobic (composting) and aerobic digestion represent the majority of the processes used in the overall management strategy of biodegradable waste. Both are processes of controlled decomposition of biodegradable material under managed conditions. However, composting, aerobically decomposes organic waste and produces compost with a release of CO_2 and heat suitable for thermophilic bacteria (Monfet et al., 2018). Anaerobic digestion presupposes the absence of O_2 and at temperatures suitable for mesophilic or thermophilic bacteria (Mihai and Ingrao, 2018, Vaverkova et al., 2020).

There are significant interactions between the two processes. Their combination is characterized by two main final products, compost and digestate. Compost is the solid particulate material and digestate is the semisolid (sludge-like) or liquid product. Both are sanitized and stabilized by biological treatment processes. However, for compost the final step is aerobic and for digestate is an anaerobic one. Composting is becoming a key element of integrated waste management. The production of compost has several advantages, including economic benefits, improvement of soil properties, reduction in the use of chemical fertilizers, and minimization of environmental pollution. However, composting has also drawbacks. In any case, composting has proven its effectiveness as the highly recommended practice for organic waste management for decades and the corresponding composting technologies are numerous and can be classified in open, enclosed and reactor technologies. The liquid digestate may also be used on farmland as organic fertilizer (Tuomela et al., 2020).

3. Analysis on existing legislation for compost certification

The concept of biodegradable waste is appeared for the first time in the Hellenic Joint Ministerial Decision 29407/3508/2002, which is intended to harmonize the Greek legislation with Directive 1999/31/EC. The term “biodegradable waste” is defined as any waste capable of being anaerobically or aerobically decomposed. This legislative initiative established strict operating and technical requirements for waste and landfills to identify measures, procedures and guidelines to prevent or reduce adverse environmental impacts as far as possible. Greece, in line with the requirements of the relevant EU directive, is committed to reduce the amount of biodegradable waste intended for disposal at landfills. The concept of biowaste, as a separate category of waste, was regulated in Greece by Law 4042/2012. Art. 11 defines that biological waste (bio-waste): “Biodegradable garden and park waste, domestic food and kitchen waste, restaurants, catering and retail outlets, and associated waste from food processing plants”. Art. 45 sets out the appropriate measures and minimum requirements, where appropriate, to encourage: I. Separate collection of biowaste for the purpose of composting and fermentation of biowaste; II. Treatment of biowaste in a way that ensures a high level of environmental protection, III. The use of environmentally friendly materials produced from biowaste. Energy recovery is also promoted in the form of practices with low environmental impact which produce secondary gas or liquid fuels for the generation of energy.

Facilities of producing compost for separated organic fraction of MSW can be constructed and operated by Municipal Authorities, as long as the daily capacity of waste entering them ranges from 1-20 t (Category B; Law 4014/2011). The Joint Ministerial Decision 171914/2013 also sets requirements and specifications for the promotion of such composting facilities in line with Directive 2006/799/EC. The requirements set very high standards for all compost uses, based on the established ecological criteria and the related assessment and verification requirements for the award of the Community eco-label. In the case of other degradable waste such as animal husbandry excrements (solid and liquid manure), slaughterhouse residues and waste of meat production important legislation is included in EU Regulation 1069/2009 “Laying down health rules as regards animal by-products and derived products not intended for human consumption and repealing Regulation (EC) No 1774/2002 (Animal by-products Regulation)”, EU Regulation 749/2011 amending Regulation (EU) No 142/2011; “Implementing Regulation (EC) No 1069/2009 of the European Parliament and of the Council laying down health rules as regards animal by-products and derived products not intended for human consumption and implementing Council Directive 97/78/EC as regards certain samples and items exempt from veterinary checks at the border under that Directive (Text with EEA relevance)” and corresponding regulations. In addition, the Circular 3891/134991 (Hellenic Republic, 2016) issues guidelines to: (i) livestock farms and slaughterhouses for the management of manure produced on these facilities, (ii) biogas/composting installations which receive and manage the generated decomposition residue to comply with the legal requirements of Regulations 1069/2009 and 142/2011. Last but not least, it is important to note Joint Ministerial Decision 56366/4351/2014, which determines the main requirements and specifications for treatment operations in the context of mechanical-biological treatment of mixed municipal waste and the characteristics of the materials produced (standards, LVs etc) according to their uses, in accordance with sub-paragraph b of paragraph 1 of article 38 of Law 4042/2012 (24/A).

Another crucial element is information and awareness of the local communities that produce biodegradable waste to the various stages of planning of the IBWT until the final operation. Figure 3.1 illustrates a roadmap towards efficient public awareness from the conception stage until the operation of the facility. Public awareness and correspondingly social acceptance are critical during the conception phase. To that end, competent authorities of the municipalities are the main responsible to assist citizens to become familiar with new concepts, practices and technologies and to persuade biodegradable waste consumers of all categories to participate efferently in the overall effort. Considering the NIMBY syndrome (Bekchanov and Mirzabaev, 2018; Kokkinos et al., 2019), this process can play a vital role towards the overall efficiency of the whole IBWT project.

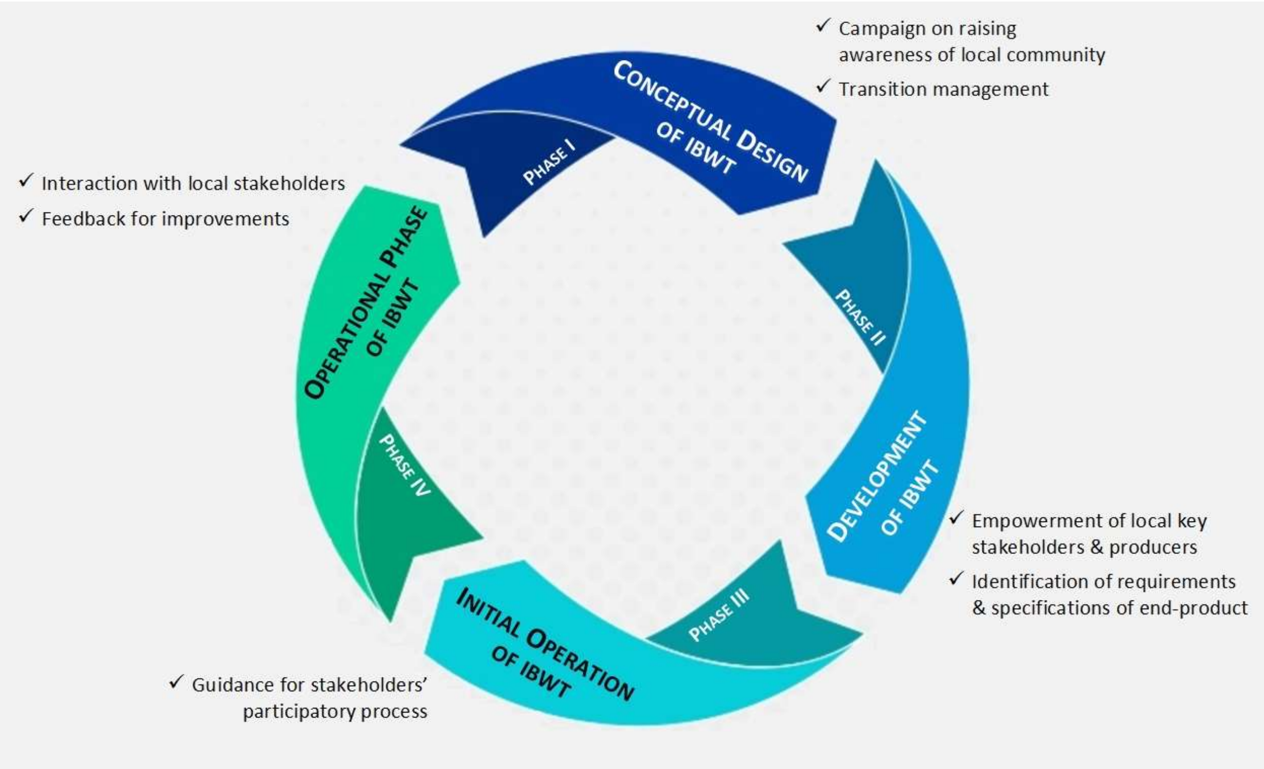

Figure 3.1. Awareness raising initiatives in the different phases of IBWT development

4. Guidance for compost certification

This chapter presents a decision support system (DSS) towards guiding for efficient production of compost and digestate that origin from biodegradable waste installations of biological treatment. The DSS can be generically applied and demonstrated to support organized decision making for a real-case scenario in the Region of Serres, Greece. The developed DSS provides a roadmap to public authorities (municipal, regional), producers and stakeholders to follow the essential basic steps regarding safe and environmentally friendly production of high-quality final product (compost and/or digestate). A product that will contribute to the qualitative soil upgrade and rational use of resources in the frames of circular economy. Interactions and managerial insights are also highlighted to optimally manage pre-dispositioned biodegradable waste. Localization is a prerequisite to achieve economies of scale. In this context, the present work frames a consistent generic methodology that is able to assist research community, the private sector and policy/decision-makers to improve their decision support procedures towards producing affordable and sustainable compost and digestate recovered from waste, supporting the transition to a low carbon future and sustainable development.

The discrete steps of the strategic decision support framework follow the conceptual illustration in Figure 4.1. In this context, the first step is to firmly decide on the Area of Concentrated Biodegradable Waste (ACBW). The important factor in an ACBW is the availability of waste for each typology present in the area, its patterns of seasonality, the concentration of biodegradable waste (e.g. t/km^2), their quality and the potential of creating relevant supply chains. Characteristic typologies can be found in the Waste Framework Directive (European Commission, 2008) and related regulations in the national legislation of the candidate ACBW. This is important to "immunize" the Installation of Biodegradable Waste Treatment (IBWT) to unstable operation, thus enhance continuous feed and long-term sustainability. Supply chain management requirements (i.e. logistics, storage etc.) should also be considered. Transportation cost is an important factor in the development of the logistics network. All the above analysis promotes specific typologies of biodegradable waste for focusing and deciding on the combination of technological solutions for the IBWT.

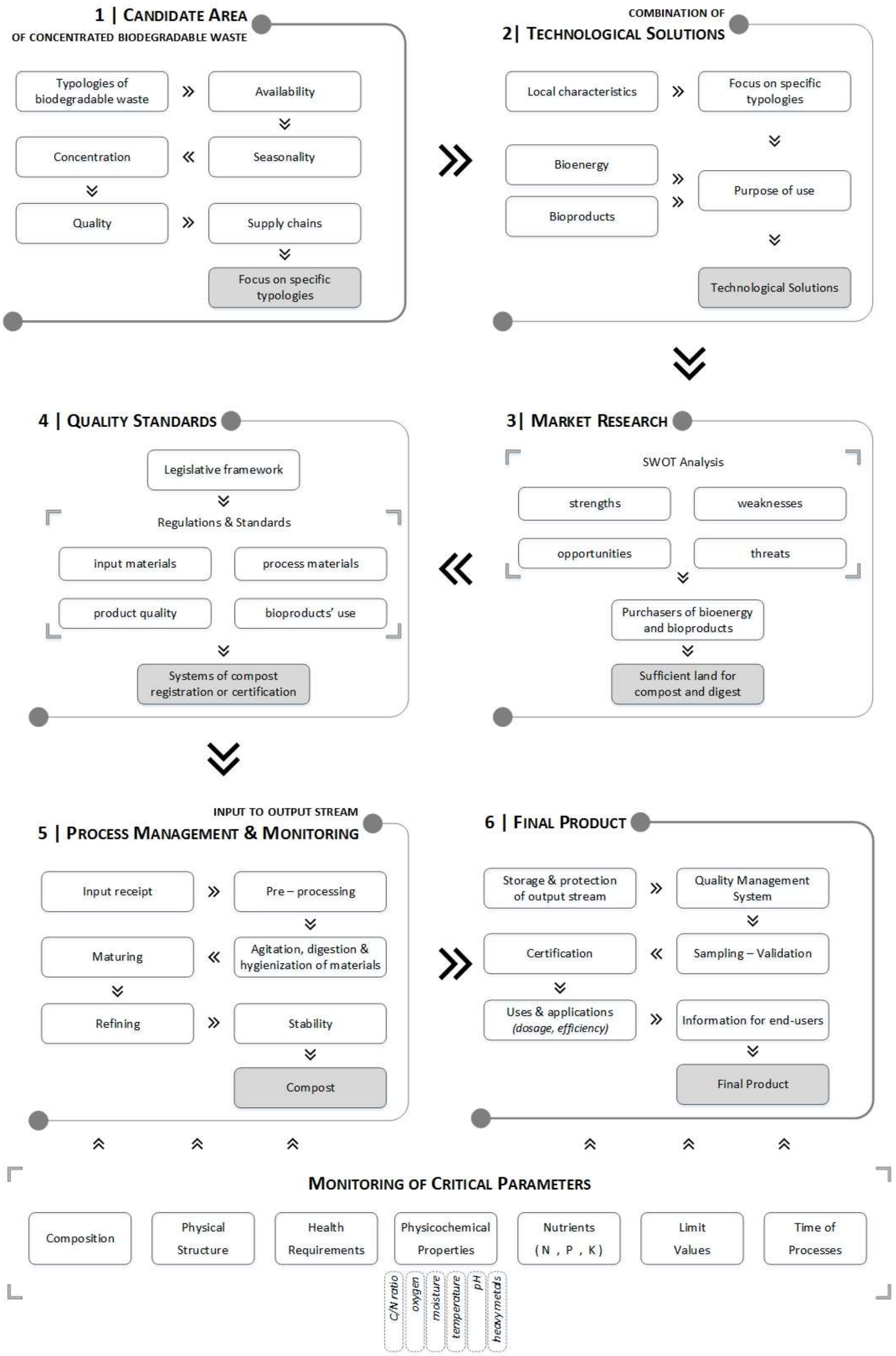

Figure 4.1. Discrete steps of the strategic decision support framework towards efficient production of bioenergy and bioproducts that origin from IBWT

Necessity and feasibility of the IBWT should be clearly defined, based on the typologies selected for treatment in the ACBW. The purpose of use includes bioenergy (heat & electricity) and bioproducts, such as compost and digestate. The appropriate uses of compost depend on source material type, compost class and quality. Agriculture requires standard quality. However, the existence of a market demand and a specific use for compost and digestate should be identified as the next step in the DSS. In this context, strengths, weaknesses, opportunities, and threats, guaranteed purchasers of bioenergy and bioproducts and enough land for compost and digest is crucial to be analyzed (Awasthi et al., 2020).

The above steps are followed by an important stage, i.e. the identification of the conditions for conformity with standards and quality requirements and the relevant legislative framework for bioproducts for the ACBW. Regulations and standards on input materials (biodegradable waste), process materials (i.e. substrates in anaerobic digestion) and output materials (final bioproducts) should be investigated (i.e. composition, physicochemical properties, limit values, minimal values of nutrients), health requirements should be foreseen, and registration and certification procedures should be analytically described. Compliance with standards and legislation is strongly associated with the input-to-output process management. On this basis, efficient management from input to output is necessary to be framed. A chronological record of the quantities must be kept, both for input and output streams. Regarding biodegradable waste, nature and origin of the waste, and, where relevant, frequency of collection, mode of transport and treatment method foreseen, is information that should be available, on request, to the responsible authorities (Chia et al., 2020).

Efficient management to successfully produce bioproducts includes pre-processing activities, mainly control, removing of impurities present, shredding and agitation. Next, a decision on the time of aerobic/anaerobic procedures is needed. The speed of the degradation depends on the environment in which it occurs and on some key parameters such as C/N ratio, oxygen, moisture and porosity, temperature, pH and the physical structure of the input materials. Final steps in the process management is efficient maturing, refining (final removing of possible remaining impurities), and stabilizing for a period to predefined qualitative characteristics. Subsequently the output stream is ready for storage and protection. Measurement samples of digestate stability are carried out at the end of the full treatment (after the minimum storage period if needed) and prior to dispatch of digestate from the site of production. Each final sample shall be representative of the batch or portion of production sampled.

A Quality Management System should be available to assure the compliance with the targeted characteristics of quality. Composting cuts down the volume of the material and its further degradability. The final product is ready to enter the market, as soon as fulfils the technical requirements for the specific purpose referred to stage 2 and meets the existing legislation and standards applicable. The type of chemical stressors to be routinely sampled in the final products as part of the quality criteria should not only depend on their possible adverse environmental impacts but also on the probability of occurrence in the input stream. A certification is important along with the instructions for use and application. Validation of the final product is required through sampling and information for end-users depicted in the packaging material. Such information enables appropriate use of digestate and compost, minimizing the risks of environment pollution or adverse effects on humans, animals or plants. On this basis, adequate quality is to be achieved (Chelinho et al., 2019).

Having in mind that input streams may differ in terms of characteristics and proportions it is crucial that the timescale of sampling needs to be enough for controlling input, process and output material. Validation should assure compliance with the all the requirements. Important monitoring steps are depicted in Figure 4.2.

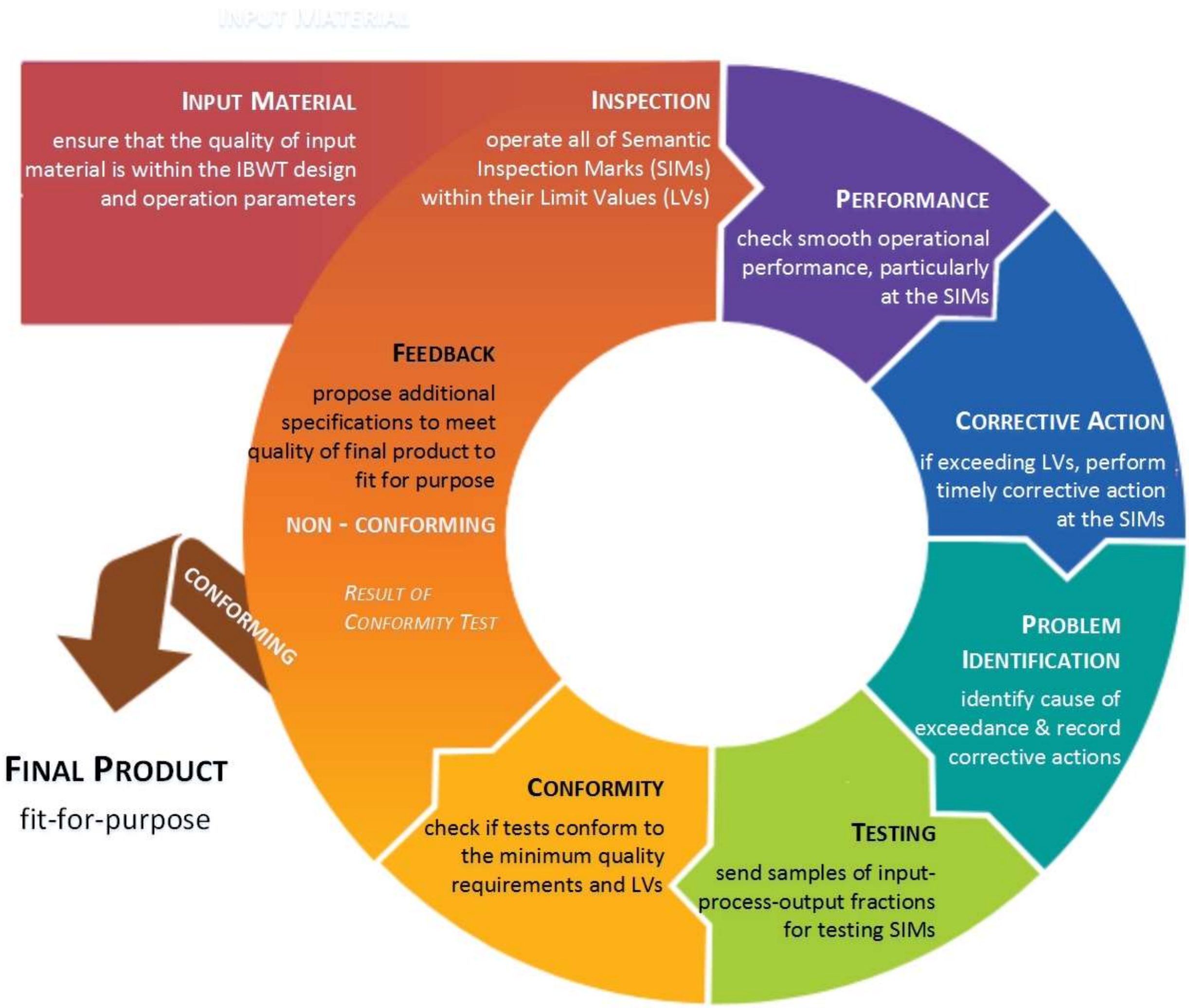

Figure 4.2. Monitoring rationale and validation steps

5. Conclusions

The material herein presented a decision support system (DSS) towards efficient production of bioproducts, such as compost, digestate and biogas that origin from biodegradable waste installations of biological treatment. The policy maker may follow discrete stages and steps in order to move into a roadmap for producing high-quality final products. Important elements of the DSS is the candidate area for the installation, the pool of available technological solutions, quality standards and legislation, market research, process management and monitoring and promotion of the final product.

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