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Compost Life Cycle and Unveiling the Journey of Recycling Organic Waste through the Composting Process: Libya as a case study

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دورة حياة السماد والكشف عن رحلة إعادة تدوير النفايات العضوية من خلال عملية التسميد: ليبيا كدراسة حالة

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Abstract:
The Compost Life Cycle Infographic illustrates the fascinating journey of recycling organic waste through the composting process. It provides a concise visual representation of the different stages of converting organic waste into nutrient-rich compost and highlights the importance of composting for sustainable waste management. The conducted study is considering in Umm Al-Aranib region that located in southern southwest of Libya. The infographic starts by showing the collection of organic waste such as food scraps, garden waste and agricultural residues. These materials are diverted from landfills to composting facilities, reducing the amount of waste that can cause environmental degradation.

Keywords: Compost Life Cycle, Organic waste, Nutrient-rich compost, Agricultural residues, Environmental degradation.

الملخص
يوضح الرسم البياني لدورة حياة السماد الرحلة الرائعة لإعادة تدوير النفايات العضوية من خلال عملية التسميد. وهو يقدم تمثيلاً مرئيًا موجزًا للمراحل المختلفة لتحويل النفايات العضوية إلى سماد غني بالمغذيات ويسلط الضوء على أهمية التسميد في الإدارة المستدامة للنفايات. أجريت الدراسة في منطقة أم الأرانب الواقعة جنوب غرب ليبيا. يبدأ الرسم البياني بإظهار مجموعة النفايات العضوية مثل بقايا الطعام ومخلفات الحدائق والمخلفات الزراعية. ويتم تحويل هذه المواد من مدافن النفايات إلى مرافق التسميد، مما يقلل من كمية النفايات التي يمكن أن تسبب تدهورًا بيئيًا.

الكلمات المفتاحية: دورة حياة السماد، النفايات العضوية، السماد الغني بالمغذيات، المخلفات الزراعية، التدهور البيئي.

Introduction

Composting is a natural process that transforms organic waste into nutrient-rich compost, which can be used to enrich soil and support plant growth [1]. Understanding the composting process and the journey of organic waste as it goes through various stages is crucial for promoting sustainable waste management practices [2]. This article will explore the compost life cycle through an informative infographic, highlighting the key steps involved in recycling organic waste and the benefits it brings to the environment [3].

Furthermore, the infographic emphasizes the benefits of compost utilization, such as enhancing soil fertility, improving water retention, and reducing the need for synthetic fertilizers [4]. It encourages individuals, communities, and businesses to incorporate composting into their waste management practices contributing to a more sustainable and circular economy [1].

In summary, the Compost Life Cycle Infographic provides a concise overview of the journey of recycling organic waste through the composting process [5]. By illustrating the stages involved and highlighting the benefits, it aims to raise awareness about the importance of composting in sustainable waste management and promoting environmental stewardship. The main contribution of this article is considering on providing a case study of the Compost Life Cycle in Umm Al-Aranib region that located in southern Libya. Furthermore, this study conducted to determine the awareness of merchants and sellers in various stores and markets in the Umm Al-Aranib region. The remaining section of the article are organized as follows: a summary of the case study is presented in Section 2. The Unveiling the Compost Life Cycle discussion is positioned in In Section 3. In Section 4 demonstrated and discussed the obtained results. The article is closing by the summery of the conclusion in Section 5 and followed by the list of recent references.

Cases study

In the country of Libya, when a customer goes to stores for shopping, the seller in those stores presents the purchases in plastic bags [6]. This study was conducted to determine the awareness of merchants and sellers in various stores and markets in the Umm Al-Aranib region (a suburbs of Murzuq), located in southern Libya as presented in Figure 1 which is approximately away 140 Km from the city of Sebha (Capital of Libyan southern cites).

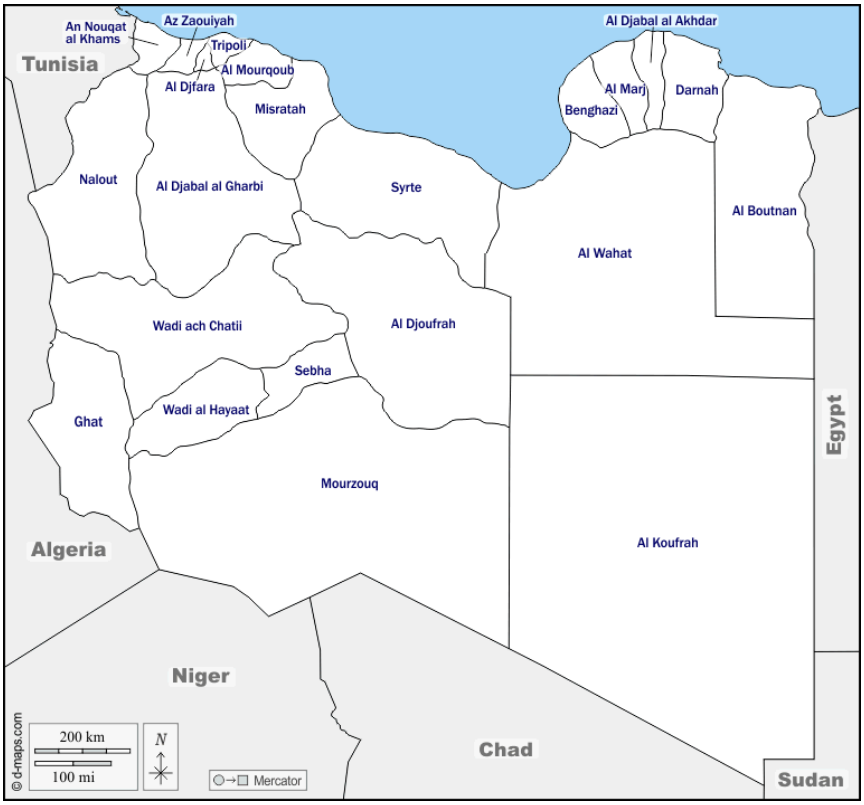

Figure 1: Case study map.

In many cases, these bags are free, lightweight, and of different sizes and colors [7]. The seller also sorts the customer's goods into a number of bags to ensure that they do not Mixing goods together, for example, putting cleaning materials in separate bags from food items, and so on. Such a step results in many plastic bags. Since 1869 AD, plastic products have increased from one million tons per year to about 380 tons. As is known, plastic threatens the environment and environmental systems, as it does not decompose naturally and remains for years until it decomposes and may reach the seas and oceans and affect the natural landscape. Studies show that plastic bags take about 1,000 years to decompose [8].

In most cases, these bags or bags end up as garbage and may be transported over long distances, reaching tens or hundreds of kilometers. It may enter the food chain when consumed by livestock and others. It may also reach bodies of water, forests and gardens and cause damage to the general and natural landscape. It may also reach factories, stations and others and cause malfunctions in engines and devices, in addition to blocking sewage pipes. When it enters the sewage networks [9].

Some merchants in the third world states burn the remains of the bags in which their goods are stored after classifying and arranging them on the shelves, which is considered another manifestation of environmental pollution with the toxic gases that result from burning, which cause damage to the respiratory system in addition

to the unpleasant odors that burning produces in addition to the fumes. Therefore, governments, including the Malaysian government, are trying to reduce plastic consumption by reducing, recycling, and reusing plastic, which is known as R3, which means reducing, reusing, and finally recycling.

In the country of Malaysia, in the past, most stores provided plastic bags to their customers to carry their goods from those stores for free. As a result of the government's understanding of the negative impact of plastic on the environment in the long term, the Malaysian government-imposed laws and legislation to limit the use of these bags, starting in 2011 [10]. One of these measures is no bags. Plastic on Saturday. Then restrictions were imposed throughout the week, so stores stopped providing bags, and customers became responsible for bringing their own bags to carry the goods they purchased, and a monetary value was imposed on the bags.

There is growing recognition of the negative effects of plastic waste on the environment. However, large quantities of plastic continue to be produced. Because plastic is lightweight, strong, durable, and cheap, it is used in the manufacture of products including pipes and shoes. The plastic bag industry was initially promoted by the oil industry. and gas in the United States in the 1970s [11]. Polyethylene is the primary material for single-use thin-film plastic bags made primarily from fossil fuel by-products [12]

The lack of environmental awareness and lack of knowledge about the problems of plastic waste may be one of the reasons that contribute greatly to the spread of plastic bags. In order to save our plants from the plastic wastes by following the stages presented in Figure 2. In addition to the negligence of companies that work to collect garbage, also the lack of private companies for the sorting and recycling process, and the idea of recycling is not widespread [13]. Sufficient in the study area. In addition, citizens are not aware of plastic problems, and there are no alternatives to plastic bags in stores and markets.

There are not yet any strict legislation or laws that prevent or limit the excessive use of plastic bags [6]. The lack of control over plastic bag factories has helped the spread of the plastic bag trade. Bag licenses in study areas have contributed to its spread. A large number of plastic products can be seen in the garbage thrown on the sides of public roads and in random dumps in Libyan villages and cities [8].

Figure 2: Flowchart of zero waste achievements.

Unveiling the Compost Life Cycle

The infographic depicts the decomposition phase, where microorganisms, including bacteria, fungi, and worms, and break down the organic matter [14]. This process generates heat, which helps eliminate pathogens and weed seeds, resulting in a safe and sanitized compost product [15]. The infographic then highlights the importance of proper maintenance during composting [16]. It emphasizes the need for regular turning or agitation to ensure adequate oxygen supply and moisture levels, promoting the optimal conditions for microbial activity and decomposition. As the composting process progresses as illustrated in Figure 3, the infographic showcases the maturation phase, where the organic matter continues to break down, resulting in a stable and nutrient-rich compost product. This mature compost is dark, crumbly, and earthy in texture, and it is ready to be used to enrich soil and support plant growth [16].

Figure 3: Compost life cycle [17].

Section 1: Organic Waste Collection
The compost life cycle begins with the collection of organic waste from various sources, such as households, restaurants, and food processing industries. This waste includes food scraps, yard trimmings, and other biodegradable materials.
Section 2: Sorting and Preprocessing
At a composting facility, the collected organic waste undergoes sorting and preprocessing. Contaminants like plastics and non-biodegradable materials are removed, ensuring a high-quality feedstock for the composting process.
Section 3: Composting
The composting stage is where the magic happens. The organic waste is placed in large composting piles or bins, where it is exposed to optimal conditions of moisture, temperature, and oxygen. Microorganisms, including bacteria and fungi, break down the organic matter through decomposition.
Section 4: Composting Factors
This section highlights the key factors influencing the composting process, such as temperature, moisture content, and aeration. Maintaining the right balance of these factors is essential for efficient decomposition and the prevention of odors and pathogens.
Section 5: Microbial Activity
Microorganisms play a vital role in the composting process. The infographic illustrates the activity of bacteria, fungi, and other beneficial microorganisms as they break down organic matter into simpler compounds, releasing carbon dioxide and heat.
Section 6: Decomposition Timeline
This section provides a timeline showcasing the stages of decomposition, from initial breakdown to the formation of humus-rich compost. It emphasizes that the composting process requires time and allows viewers to understand the gradual transformation of organic waste into valuable compost.
Section 7: Benefits of Compost
The infographic highlights the numerous benefits of compost, including the tabulated benefits in Table.

Table 1: Benefits of Compost.

Benefits of Compost	Explanations
Enriching Soil	Compost improves soil structure, enhances moisture retention, and promotes nutrient availability, creating a healthy environment for plant growth.
Carbon Sequestration	Compost helps sequester carbon dioxide from the atmosphere, mitigating climate change by reducing greenhouse gas emissions.
Waste Reduction	Composting diverts organic waste from landfills, reducing methane emissions and extending the lifespan of landfills.
Sustainable Agriculture	The use of compost reduces reliance on synthetic fertilizers, minimizing environmental pollution and supporting sustainable agricultural practices.

A form of recycling called composting focuses on recycling and reusing organic waste, such as food scraps, as opposed to recycling materials like paper, plastic, or aluminium as shown in Figure 4. The majority of food scraps, whether they are too much to consume or are inedible (like banana peels), can be composted. Any other organic material that comes straight from the ground, such as grass clippings, fall foliage, and even animal waste, can also be composted.

Figure 4: Benefits of Compost.

Section 8: Application of Compost
The infographic concludes by showcasing the various applications of compost, such as landscaping, agriculture, and home gardening. It emphasizes how compost completes the cycle by nourishing plants and returning organic matter back to the soil.
The plastics business must adjust to the ever-present trends of recycling and sustainability as presented the Global Consumer Packaging Market percentages in Figure 5. According to a recent study by market analysts with large banking institution Citi, "Rethinking single-use plastics," the key finding is the prognosis. Though an embargoed version of the study does not offer concrete advice to plastics packagers, the researchers do a thorough job of illustrating the conflict that exists between plastics, paper, metal, and glass in packaging [1].

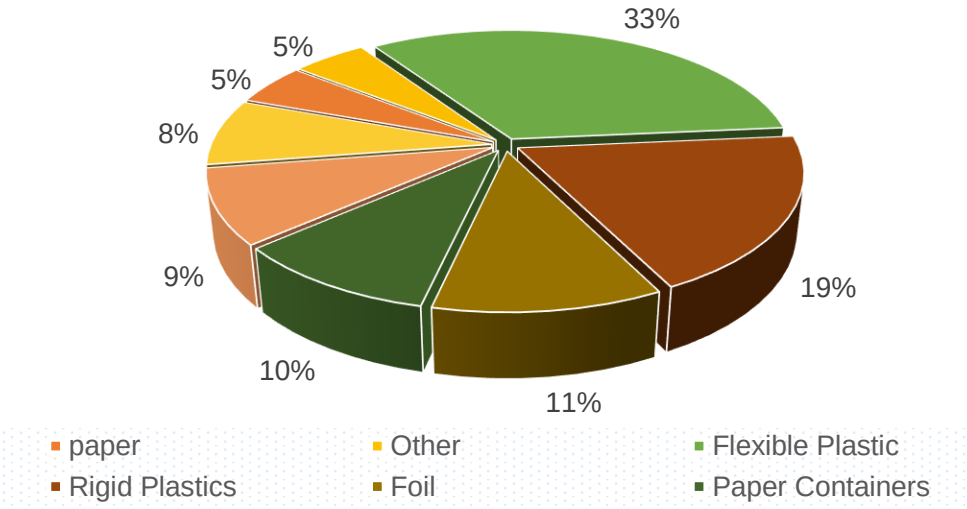

Figure 5: Global Consumer Packaging Market.

Results and discussion
Using Libya as a case study, the compost life cycle results illustrate the potential advantages of composting in enhancing waste management, soil quality, and agricultural productivity. Nonetheless, the effective execution and expandability of composting methods throughout the nation will depend on tackling the current obstacles and creating a conducive environment.

Using the compost life cycle in Libya as a case study, important findings have been obtained that highlight the advantages and difficulties of composting in the nation. The summary discussion of the findings is listed Table 2.

Table 2: The main findings of compost life cycle.

Findings	Features
Waste Management Improvement	• The implementation of composting processes has resulted in a notable improvement in waste management practices in Libya. • Composting allows for the diversion of organic waste from landfills, reducing the environmental impact and promoting a more sustainable waste management system.
Organic Waste Diversion	• Composting has proven to be an effective method for diverting organic waste from disposal sites. • By composting organic materials such as food waste, yard trimmings, and agricultural residues, valuable resources are recovered and transformed into nutrient-rich soil amendments.
Soil Enrichment	• The compost produced through the life cycle of organic waste has demonstrated its potential in enriching soil quality. • The application of compost helps improve soil structure, enhances water retention capacity, and increases nutrient content, leading to healthier and more productive soils.
Agricultural Benefits	• The utilization of compost in agriculture has shown promising results in Libya. • Compost application enhances soil fertility, reduces the need for synthetic fertilizers, and promotes sustainable agricultural practices. • It has the potential to improve crop yields, particularly in areas with degraded soils.
Environmental Impact	• Composting contributes to reducing greenhouse gas emissions by minimizing the release of methane gas from landfills. • Composting helps mitigate soil erosion, promotes biodiversity, and reduces the need for chemical pesticides and fertilizers, thereby reducing the overall environmental footprint.
Challenges	• Despite the positive outcomes, there are challenges associated with implementing composting practices in Libya. • These challenges include limited infrastructure and facilities for composting, lack of awareness and education about composting techniques, and the need for policy support and regulations to encourage widespread adoption of composting practices.

Conclusion

The compost life cycle infographic provides a visual representation of the journey of organic waste through the recycling process. By understanding the steps involved in composting and the benefits it brings, individuals, communities, and businesses can embrace sustainable waste management practices. Composting not only reduces the environmental impact of organic waste but also creates valuable resources that support soil health, plant growth, and sustainable agriculture. Through effective communication and education, the compost life cycle infographic can inspire individuals to participate in composting initiatives and contribute to a greener and more sustainable future.

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