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Safer Biosolids Use in Spanish Agriculture

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Why does it matter now?

The sustainable management of wastewater treatment plant (WWTP) biosolids presents a significant opportunity for nutrient recovery and circular economy principles within European agriculture. Biosolids can serve as a valuable alternative to synthetic fertilizers, reducing reliance on finite resources and mitigating greenhouse gas emissions. However, their use is not without potential risks. This brief examines the current regulatory landscape in Europe, highlights the specific challenges and practices, and proposes policy recommendations to ensure the safe and sustainable application of biosolids as fertilizer, safeguarding human health and environmental integrity.

Spain recycles a very high share of its sewage sludge to farmland (~80–84% in 2020), so choices made here disproportionately shape soil quality, food safety, and public trust. The EU Sewage Sludge Directive (86/278/EEC) is outdated and does not adequately cover contaminants of emerging concern (CECs); several Member States already go beyond EU minima or restrict use. Spain's framework (Real Decreto 1310/1990; Orden AAA/1072/2013) focuses mainly on metals and permitted soils/uses; updating it to today's contaminants and treatment realities will protect soils while preserving nutrient circularity.

- Spain is among the EU's highest users of biosolids on land; any missteps scale up quickly, while good practice pays off nationally.
- The 2023 Commission evaluation flags narrow pollutant coverage, limited monitoring of CECs, and uneven controls across Member States.
- Adequate monitoring and source control makes it possible to avoid inherent health risks in biosolids use in the agriculture

Benefits

Biosoilids used as fertilizers provide soil with necessary elements such as phosphorus and nitrogen in a bioavailable form, additionally enhancing soil structure and water retention. Their origin from waste materials makes them cost efficient and in line with EU regulations such as Green Deal and Circular Economy Act

Risks

Biosolids, although rich in nutrients, are sinks for numerous pollutants such as heavy metals, pathogens, and CECs (e.g., pharmaceuticals, PFAS, and microplastics), Repeated use of contaminated biosolids will spread the contamination into the soil and agriculture products.

- **Bioaccumulation:** Transfer of heavy metals from soil to leafy vegetables, posing long-term risks to the food chain.
- **Direct Exposure**: Pathogen persistence (e.g., Salmonella, Listeria) if stabilization times are insufficient or if weather conditions prevent proper solarization.
- **Toxicity Synergy**: Emerging data suggests microplastics act as vectors, increasing the bioavailability and toxicity of PFAS to soil organisms. Measuring and removing them remains methodologically challenging

Human exposure pathways include crop uptake, dust inhalation, and occupational contact, underscoring the need for cumulative-risk management rather than single-substance thresholds.

Objective

Keep the beneficial nutrients and carbon in biosolids while preventing soil and food-chain contamination, by restricting land application for only the highest-quality, transparently monitored materials

Recommended solutions

To ensure Zero Pollution goals by 2030, the following actions are required:

1. **Standardized Monitoring**

Establish an EU-wide digital tracking system for biosolid "batches" from WWTP to field, ensuring transparency in contaminant loads.

2. **Harmonized Limits**

Implement a "group-limit" for PFAS in biosolids (e.g., 20 µg/kg) rather than testing for thousands of individual compounds.

3. **Mandatory Advanced Stabilization**

Require tertiary treatment (e.g., thermal hydrolysis or solar drying) for all biosolids intended for food-crop application to eliminate pathogens and reduce volume.

4. **Incentivize Pyrolysis**

Support the transition from direct land application to biochar production. This process eliminates pathogens as well as most of the organic pollutants while retaining nitrogen and phosphorus that can be later recovered and used in agriculture.

What is succes supposed to looks like?

Risk reduction: ≥50% reduction in mean PFAS concentrations and measurable reductions in microplastics counts in land-applied biosolids; downward trends in soil hot-spots.

Quality assurance: Transparent and traceable biosolids origin with continuous monitoring of land, where biosolids were applied

Resource efficiency: Reintroduction of valuable components from the biosolids into the soil that would otherwise be wasted. Proper disposal of non compliant biosolids

Public confidence: Improvement of public reception by enforcing universal quality standards for biosolids and making data regarding the quality transparent and avalible.

Key trade-offs

Cost vs. safety: Advanced monitoring and treatment raise near-term costs. Mitigate through targeted pilots, performance-based standards, and EU/national funding aligned with circular economy and zero-pollution objectives.

Land application vs. thermal routes: Where contaminants are persistent, diverting to mono-incineration with recovery protects soils while preserving critical nutrient circularity.

Bottom line

Spain can keep the circular benefits of biosolids and protect soils and consumers by:

(i) upgrading quality standards to today's contaminant reality

(ii) enforcing source control

(iii) using only the biosolids where levels of contaminants were thoroughly investigated

(iv) making monitoring data public to earn durable social trust

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Scientific Background

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.

European Commission. (2023). Commission staff working document: Evaluation of 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 (SWD/2023/0157 final).

España. (1990). *Real Decreto 1310/1990, de 29 de octubre, por el que se regula la utilización de los lodos de depuración en el sector agrario*. *Boletín Oficial del Estado*, 262.

España. (2013). *Orden AAA/1072/2013, de 7 de junio, sobre utilización de lodos de depuración en el sector agrario*. *Boletín Oficial del Estado*, 142.

Rigueiro-Rodríguez, A., Amador-García, A., Ferreiro-Domínguez, N., Muñoz-Ferreiro, N., Santiago-Freijanes, J. J., & Mosquera-Losada, M. R. (2018). Proposing policy changes for sewage sludge applications based on zinc within a circular economy perspective. Land use policy, 76, 839-846.

Leino, O., Äystö, L., Fjäder, P., Perkola, N., & Lehtoranta, S. (2025). Contaminants of environmental concern in sewage sludge in the Nordic countries. *Environmental Pollution*, *381*, 126604.

Koumoulidis, D.; Varvaris, I.; Pittaki, Z.; Hadjimitsis, D. Sewage Sludge in Agricultural Lands: The Legislative Framework in EU-28. Sustainability 2024, 16, 10946

Godfree, A. (2007). Health constraints on the agricultural recycling of wastewater sludges. *Handbook of water and wastewater microbiology*, 281.

Marchuk, S., Tait, S., Sinha, P., Harris, P., Antille, D. L., & McCabe, B. K. (2023). Biosolids-derived fertilisers: A review of challenges and opportunities. *Science of the Total Environment*, *875*, 162555.

Ajayi, A. O., Odeyemi, A. T., Akinjogunla, O. J., Adeyeye, A. B., & Ayo-ajayi, I. (2024). Review of antibiotic-resistant bacteria and antibiotic resistance genes within the one health framework. *Infection Ecology & Epidemiology*, *14*(1). https://doi.org/10.1080/20008686.2024.2312953

Aghanaghad, M., Asgari, E., Sheikhmohammadi, A., & Tajfar, H. (2025). Health risk assessment of heavy metals/metalloid caused by using sewage sludge in agriculture. *Desalination and Water Treatment*, *321*, 100977.

Zhang, Z., & Chen, Y. (2020). Effects of microplastics on wastewater and sewage sludge treatment and their removal: A review. *Chemical Engineering Journal*, *382*, 122955.

Alvim, C. B., Valiente, S. N., Bes-Piá, M. A., & Mendoza-Roca, J. A. (2022). Methodology for removing microplastics and other anthropogenic microparticles from sludge dewatering system. *Journal of environmental management*, *314*, 115010.

Li, X., Chen, L., Ji, Y., Li, M., Dong, B., Qian, G., ... & Dai, X. (2020). Effects of chemical pretreatments on microplastic extraction in sewage sludge and their physicochemical characteristics. *Water Research*, *171*, 115379.

Ekane, N., Barquet, K., & Rosemarin, A. (2021). Resources and risks: Perceptions on the application of sewage sludge on agricultural land in Sweden, a case study. Frontiers in Sustainable Food Systems, 5, 647780.

Karef, S., Azlaoui, M., Boussaid, K., Batana, F. Z., Bruzzoniti, M. C., Fodili, M., & Kettab, A. (2025). Fertilizer potential and social perception of the agricultural reuse of sewage sludge and treated wastewater. Desalination and Water Treatment, 322, 101186.