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Systematic Map Protocol

Title
What evidence exists on the potential of Technosols constructed from mineral wastes to host biodiversity?

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Anthroposol; Anthrosol; Circular economy; Constructed Technosol; Ecological engineering; Excavated materials; Urban construction wastes

Background
In 2018, an estimated 55.3 per cent of the world's population lived in urban settlements. By 2030, urban areas are projected to house 60 % of people globally and one in every three people will live in cities with at least half a million inhabitants [1]. The development of cities and transport infrastructures will produce a large volume of excavated materials. For instance, in France, the construction of the Grand Paris Express transport infrastructure will generate 45 million tonnes of these materials. The management of excavated materials, considered as wastes, has a substantial economic and environmental cost (e.g. greenhouse gas emissions), as they are most often stored in landfills outside the cities. At the same time, cities are increasingly trying to develop green infrastructures, given the ecosystems services they provide to people such as air filtration, micro climate regulation, noise reduction, rainwater drainage, and recreational and cultural values [2]. To build these green infrastructures, fertile soil is taken from rural areas, and this transfer also generates substantial economic and environmental costs. In a circular economy approach, building fertile soils from excavated materials from construction sites would allow cities to reduce the economic and environmental costs of both managing excavated mineral wastes and developing green infrastructures. Soils constructed from these materials must be able to support vegetation growth and become a suitable living environment for soil organisms. This requires ecological engineering to maximise the potential of constructed soils for biodiversity, both from a taxonomic and functional perspective. In this context, this paper presents a protocol to systematically map the evidence related to the potential of Technosols constructed from excavated materials to host biodiversity. The aim is to specifically identify the materials and methods used to construct Technosols and the biodiversity outcomes measured.

Theory of change or causal model
The conceptual model illustrating how the intervention, i.e. the construction of the Technosol, through the choice and organisation of materials, can influence biodiversity outcomes is described in Figure 1 (diagram based on Freepik images). The consideration of below-ground biodiversity in the construction of Technosols (e.g. by using earthworms as engineering organisms) can also influence the outcomes for above-ground biodiversity.

Stakeholder engagement
The specific issue addressed in this work was clarified during discussions with members of the ECT company (Sophie Alix, Florie Pozzi, Guillaume Pasquier), which funded this work and which specialises in the storage of inert materials from building and public works sites and manages the storage of approximately 15 million tonnes of excavated soil per year in the Île-de-France region.

Objectives and review question
The primary question of the systematic map is : What evidence exists on the potential of Technosols constructed from mineral wastes to host biodiversity?

Definitions of the question components
The question has the following key elements: Population: all living organisms (flora, fauna, microbiota, fungi, etc.). Intervention: Construction of Technosols from mineral wastes (e.g. excavated materials or sediment, concrete blocks, decontaminated soils). Comparator: Other soils or other constructed Technosols; before adding the constructed Technosol. Outcomes: All outcomes related to living organisms (presence, abundance, diversity, activity, etc.) and biological processes.

Search strategy
A search string combining keywords describing the intervention element of the question (Technosols constructed from mineral wastes) will be used. A scoping exercise in the Web Of Science Core Collection database was conducted to identify the search string that gave the highest comprehensiveness and specificity. The search string is as follows (Web Of Science format): TS=(technosol$ OR technosoil$ OR techno-soil$ OR anthroposol$ OR anthroposoil$ OR "anthropogenic soil$" OR anthrosol$ OR anthrosoil$ OR "construct* soil$" OR "engineered soil$" OR "rebuilt soil$" OR "artificial soil$" OR "fabricated soil$" OR "structural soil$" OR "excavated soil$" OR "inert soil$" OR "excavated material$" OR "excavated earth" OR "inert material$" OR "surplus soil$" OR "urban construction waste$")

Bibliographic databases
The search will be conducted on two bibliographic databases : Scopus (Elsevier) and Web of Science Core Collections (WOS CC, Clarivates Analytics). Access to the databases will be through a CNRS (the French National Centre for Scientific Research) subscription, allowing access to the following WOS CC Citation Indexes: Science Citation Index Expanded (SCI-EXPANDED, 1900-present); Social Sciences Citation Index (SSCI, 1956-present); Arts & Humanities Citation Index (A&HCI, 1975-present); Conference Proceedings Citation Index- Science (CPCI-S, 1998-present); Conference Proceedings Citation Index- Social Science & Humanities (CPCI-SSH, 1998-present); Emerging Sources Citation Index (ESCI, 2015-present); Current Chemical Reactions (CCR-EXPANDED, 1985-present, includes Institut National de la Propriété Industrielle structure data back to 1840); Index Chemicus (IC, 1993-present).

Web-based search engines
Additional search will be performed using Google Scholar web search engine. Searches will be performed on title using the adapted search string : technosol OR technosols OR technosoil OR technosoils OR anthroposol OR anthroposols OR anthroposoil OR anthroposoils OR anthrosol OR anthrosols OR anthrosoil OR anthrosoils. All records will be kept and results will be extracted using the software Publish or Perish (version 7.15.2643.7260, https://harzing.com/resources/publish-or-perish, version accessed 16 March 2020).

Organisational websites
Additional searches will also be performed on the following organisational websites: - The Food and Agriculture Organization (FAO) (https://www.fao.org/about/en/) - The European Circular Economy

Stakeholder Platform (https://circulareconomy.europa.eu/platform/en) - The French Agency for Ecological Transition (ADEME) (https://www.ademe.fr/) - The French Biodiversity Agency (OFB) (https://www.ofb.gouv.fr) - The resources centre for ecological engineering of the French Biodiversity Agency (https://www.genieecologique.fr/) - The Paris Region Institute (https://www.institutparisregion.fr/) - The French Geological Survey (BRGM) (https://www.brgm.fr/) - The Centre for landscape and urban horticulture (Plante & Cité) (https://www.plante-et-cite.fr/) Although the systematic map has no geographical restrictions (eligible studies from all countries will be included), most of the organisational websites that will be consulted are French, as France is very active in the field of Technosols construction from mineral wastes and specific organisations in other countries are difficult to identify by the review team (language barrier).

Comprehensiveness of the search
To assess the comprehensiveness of the search, a list of 19 articles answering the review question was built. Articles were mainly selected from the references lists of reviews on the subject [3–5] and from a master thesis aiming at reviewing all the literature on Technosols [6].

Search update
No search update is anticipated as the systematic map will be processed within one year after protocol registration.

Screening strategy
Articles will be screened for eligibility in two successive stages: first on titles and abstracts, and second on full-texts. Articles without an abstract and retained based on title screening will directly be screened on their full-text. Articles with unclear eligibility status during title/abstract screening will be included for full text screening. The list of articles with unclear eligibility status after completion of full-text screening will be provided with explanation of why they could not be classified. Screening will be performed by at least two reviewers. Before screening, we will assess the consistency between reviewers' decisions (see Consistency check).

Eligibility criteria
Articles will be screened according to the following eligibility criteria: Population: includes all living organisms (flora, fauna, microbiota, fungi, etc.). Intervention: includes construction of Technosols from mineral wastes (e.g. excavated materials or sediment, concrete blocks, decontaminated soils). Excludes polluted materials. Comparator: includes other soils or other constructed Technosols, or before adding the constructed Technosol. Outcomes: includes all outcomes related to living organisms (presence, abundance, diversity, activity, etc.) and biological processes. Language: includes English and French (the languages understood by the review team) Type of document: includes journal articles, reports, book chapters, conference proceedings, Ph.D. or M.Sc. thesis, and preprints. Excludes presentations, editorial materials, news, abstracts, posters, and datasets. Type of content: includes in-situ or ex-situ studies. Excludes reviews, meta-analyses, modelling studies without experimental data, discussion or opinion papers. No geographical restrictions will be applied.

Consistency checking
We will assess the consistency between reviewers' decisions by computing the Randolph's Kappa coefficient on a number of references (5% of the total) randomly sampled among the set of articles. We will consider a minimal coefficient of 0.6 as an acceptable level of agreement between reviewers, and the process will be repeated until reaching this level. All disagreements between reviewers will be discussed whatever the value of the coefficient, and the definition of eligibility criteria will be improved where necessary.

Reporting screening outcomes
The outcomes of the screening will be reported in a ROSES flow diagram, and the list of eligible articles after full text screening will be provided. The list of articles excluded at full text will also be provided with reasons for exclusion.

Study validity assessment
No critical appraisal of study will be performed for the systematic map.

Consistency checking
N/A

Data coding strategy
A list of variables will be recorded in a spreadsheet from full-texts for all studies included in the map. One trained reviewer will perform the coding (see Consistency check).

Meta-data to be coded
The following variables will be extracted where possible : - Bibliographic information (unique identifier, source, title, authors, journal, year, DOI, language and type of document) - General description of the study (country, location, experimental system, reason for intervention, land use) - Description of the population (taxon, is the population a construction element of the soil?) - Description of the intervention (description of the inert soil, of the other materials used, and of the organisation of materials, age of the soil/time since intervention) - Description of the type of the outcome

Consistency checking
Before the actual coding, a random sample of studies (10%) will be coded by at least two reviewers to train the reviewer that will perform the data coding. All disagreements between reviewers will be discussed and the data extraction strategy will be improved where necessary.

Type of mapping
We will produce a database (spreadsheet) of all included studies and their coded data. This database will be open access and included as an appendix to the systematic map report.

Narrative synthesis methods
The studies included in the systematic map will be described through their geographical distribution, and frequency distribution into the types of study, and types of population, intervention and outcomes studied.

Knowledge gap identification strategy
Knowledge gaps will be identified through the frequency distribution of the studies into the types of population, intervention and outcomes studies. A heatmap of the frequency of the studies into the types of intervention and types population (or outcome) studied will also be used.

Demonstrating procedural independence
During all screening and data coding process, we will ensure that reviewers will never have to screen or code their own articles.

Competing interests
The authors declare that they have no competing interests.

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Author’s contributions

DYO, RS and YR clarified the question in discussion with the ECT company. DYO, RS, YR and TL defined the search string. DYO produced a first draft of the protocol that was reviewed by TL, RS and YR. All authors read and approved the final protocol.

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References

1. United Nations, Department of Economic and Social Affaires, Population Division. The World’s Cities in 2018 - Data booklet [Internet]. UN; 2018 [cited 28 juin 2022]. https://www.un-ilibrary.org/content/books/9789210582766 2. Bolund P, Hunhammar S. Ecosystem services in urban areas. Ecol Econ. 1 mai 1999;29(2):293-301. 3. Deeb M, Groffman PM, Blouin M, Egendorf SP, Vergnes A, Vasenev V, et al. Using constructed soils for green infrastructure – challenges and limitations. SOIL. 8 sept 2020;6(2):413-34. 4. Fabbri D, Pizzol R, Calza P, Malandrino M, Gaggero E, Padoan E, et al. Constructed Technosols: A Strategy toward a Circular Economy. Appl Sci. 12 avr 2021;11(8):3432. 5. Gonçalves JO, Fruto CM, Barranco MJ, Oliveira MLS, Ramos CG. Recovery of Degraded Areas through Technosols and Mineral Nanoparticles: A Review. Sustainability. 17 janv 2022;14(2):993. 6. Lopez T. Synthèse de 10 ans de recherche sur les Technosols. 2020 p. 27.

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