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GRID Geneva

GLOBAL SAND ANALYSIS SERIES

Sand and sustainability terminology

Technical report

About UNEP/GRID-Geneva

GRID-Geneva is part of the UN Environment Programme (UNEP) Science Division and a member of the Global Resource Information Database (GRID) network. Established by UNEP, the Swiss Federal Office for the Environment and the University of Geneva in 1985, our mission is to transform data into information and knowledge in support decision making processes related to environmental issues.

About this document

UNEP/GRID-Geneva established the Global Sand Observatory initiative as a direct response to requests to identify knowledge gaps under the UNEA-4 Mineral Resource Resolution (UNEP/EA.4/Res.19).

Sand resource governance is complex, spanning policy domains, stakeholders and sectors. Establishing consensus on key terms on the sand and sustainability topic is therefore key, and requires reviewing language, definitions and terminology. This will be important to initiate cross-sectoral and multi-actor discussions to define problems and update goals and key results in implementing policies and laws governing sand resources.

This document is version 1 of what will be a living repository of terms and definitions being adopted as we explore themes in sand and sustainability at UNEP/GRID-Geneva following the Mineral Resource Resolution and the UNEA-5 Environemntal Aspects of Minerals and Metals Resolution (UNEP/EA.5/Res.12).
UNEP/GRID-Geneva shares this working research product openly in the spirit of open science, giving free access for all and seeking feedback and corrections. Please contact us on sand@unepgrid.ch.

Authors

Dr. Louise Gallagher, louise.gallagher@unige.ch

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Glossary

Aggregate	Aggregate is a granular material of natural, processed, or recycled origin used essentially for construction purposes with an upper grain size limit of 75mm (UNEP/GRID-Geneva, 2022).
Primary aggregate /or/ naturally-sourced aggregate	Sand, gravel and crushed rock extracted from the natural environment (UNEP/GRID-Geneva, 2022).
Secondary aggregate/ material	Includes both recycled and reused aggregate and material (UNEP/GRID-Geneva, 2022).
Avoidance	Reduction in the use of sand resources or its substitutes through alternative urban design, land use planning, infrastructure and building design, among other approaches (UNEP, 2019).
Circular economy	An economic system in which products and materials are designed in such a way that they can be reused, remanufactured, recycled or recovered and thus maintained in the economy for as long as possible, along with the resources of which they are made, and the generation of waste, especially hazardous waste, is avoided or minimised, and GHGs are prevented or reduced (UNEP/EA.4/Res.1).
Consumption	The process by which economic agents engage in acquisition, appropriation, appreciation and disposal of goods, services, performances, information, whether purchased or not, for varied purposes, over which the agent has some discretion (Keller et al., 2017).
Efficiency	Efficiency is a broad concept that compares the inputs to a system with its outputs, essentially achieving more with less (IRP & UNEP, 2017). However different efficiencies are important in different disciplines relevant to sand and gravel sourcing, use and management. *Technical efficiency*. A producer is said to be technically inefficient when it can produce the same amount of output with less of at least one input, or can use the same package of inputs to produce more of at least one output (Koopmans, 1951) cited in (Murillo-Zamorano, 2004). One example application includes efficiency outcomes in materials

	composition, performance (strength, durability etc.) and production volumes (e.g. Papadakis & Tsimas, 2002) for efficiency analysis for supplementary or alternative cementing materials. *Economic efficiency*. Pareto efficiency is the allocation of resources so that no reallocation can make one entity (human being or business) better off without making another worse off (Hashimzade et al., 2017). In practical applications, this can be measured by criteria like improvement in productivity (value added / input) and input-use intensity (input / value added). *Distributive efficiency*. The Pareto efficiency relative to individuals' preferences concerning the whole allocation of resources (Mercier Ythier, 2010). Distributive efficiency is concerned with equitable distribution of resources so that goods and services are consumed by those who need them most. *Resource efficiency*. The goals of decoupling – increasing human well-being and economic growth while lowering the amount of resources required and negative environmental impacts associated with resource use. Achieving resource efficiency economy refers to systems of production and consumption that have been optimized with regard to resource use. This includes strategies of dematerialisation (savings, reduction of material and energy use) and re-materialisation (reuse, remanufacturing and recycling) in a systems-wide approach to a circular economy (IRP & UNEP, 2017).
Extraction	Extraction is the removal of primary (virgin, natural) sand resources from the natural environment (terrestrial, riverine, coastal, or marine) for subsequent processing or use.
Extraction rates	The rate at which sand resources are removed from the natural environment by volume over time.
Governance	The on-going interaction and co-evolution between public and/or private entities with the purpose of realising a collective interest. This process can vary in its level of institutionalisation, collaboration, and ability to adapt to change. The collective interest in the context of responsible sourcing and use of sand and its alternatives include human wellbeing, environmental quality and economic performance being maintained or enhanced equitably for resilience (Lange et al., 2013; Bodin, 2017; Baird et al., 2019; Haider et al., 2021).
Gravel	Gravel is a mineral granular material which does not stick together when wet and remoulded (i.e., non-cohesive) and

	where the combined weight of 50% of the particles is larger than 4.75mm but smaller than 75mm with less than 15% of material smaller than 75µm. Additional qualifiers are needed for a precise and correct description of gravel (UNEP/GRID-Geneva, 2022).
Inactive sand bodies	A deposit of sand that lies outside of the influence of modern erosional and depositional processes. In geological terms, these sediments can be described as relict or fossil (UNEP, 2022).
Just transitions	Socio-technical transitions towards green and circular economies involve interlinked processes to create systemic shifts in production, consumption, and waste management practices. Niche innovations in products, technologies, ideas, practices, regulations, and policies emerge in localized settings. Successful innovations reform the relevant regimes of rules and institutions, which in turn can influence wider landscapes patterns shaping interactions between social and natural systems and how they evolve and transition from one state to another (Scoones et al., 2020). A notion of a 'just transition' extends this to include consideration of both broader inclusion in decision making around transitions and distribution of costs and benefits of making these happen across different scales of geography, social groups etc., as well as the politics and power dynamics involved (Swilling, 2020). Such Just Transitions aims to smooth the shift towards a more sustainable society and providing hope for the capacity of a green economy that considers decent jobs and livelihoods for all." (UNEP, 2021a).
Mineral sand	Mineral sand is part of a class of ore deposits that are enriched in grains of heavy minerals such as ilmenite, zircon, leucoxene, and rutile.
Nature-based Solutions	Actions to protect, conserve, restore, sustainably use and manage natural or modified terrestrial, freshwater, coastal and marine ecosystems which address social, economic and environmental challenges effectively and adaptively, while simultaneously providing human well-being, ecosystem services, resilience and biodiversity benefits, and recognizes that nature-based solutions: (a) Respect social and environmental safeguards, in line with the three "Rio conventions" (the Convention on Biological Diversity, the United Nations Convention to Combat Desertification and the United Nations Framework Convention

	on Climate Change), including such safeguards for local communities and indigenous peoples; (b) Can be implemented in accordance with local, national and regional circumstances, consistent with the 2030 Agenda for Sustainable Development, and can be managed adaptively; (c) Are one of the actions that play an essential role in the overall global effort to achieve the Sustainable Development Goals, including by effectively and efficiently addressing major social, economic and environmental challenges, such as biodiversity loss, climate change, land degradation, desertification, food security, disaster risks, urban development, water availability, poverty eradication, inequality and unemployment, as well as social development, sustainable economic development, human health and a broad range of ecosystem services; (d) Can help to stimulate sustainable innovation and scientific research. (UNEP/EA.5/Res.5) Sand is a core component in many nature-based solutions, including those designed towards enhancing coastal resilience or flood management amongst others benefits.
Natural infrastructure	Also sometimes called ecological infrastructure, environmental infrastructure, or green infrastructure. Refers to a strategically planned and managed network[s] of natural lands, such as forests and wetlands, working landscapes, and other open spaces that conserves or enhances ecosystem values and functions and provides associated benefits to human populations (UNEP, 2021b).
Naturally occurring sand	Sand sourced from the natural environment, which does not include crushed rock (UNEP, 2022).
Ore-Sand (o-sand)	A type of processed sand sourced as a co-product or by-product of mineral ores. Typically, it is a result of mechanical crushing and grinding, different physical and physicochemical beneficiation processes for mineral concentrates recovery, including optimization of these processes and additional processing stages to achieve the required properties of sand (Golev et al., 2022).
Policy	'Policy' is difficult to define particularly across the varied domains that are core to sand and sustainability. Based on (Cairney, 2019:17), the term can mean: a domain of interest; an

	intended outcome or proposal for action by any policy actors; formal decisions taken by government, private sector or other actors or the process to take such decisions; government plans, programmes, legal frameworks or legislation. In sand and gravel governance, this is a polycentric and multi-level policy environment where state actors are just one, albeit critical, policy actor (van Leeuwen, 2015; Heikkila et al., 2018; Morrison et al., 2019; Partelow et al., 2020).
Policy domains	Components of the political system organized around a substantive issue. Other terms used with the same meanings: "Policy areas", "policy sectors", "subsystems", "dimensions", "programs/programmes". Some recognisable policy domains are energy, health, transportation and agriculture (Burstein, 1991: 32). In sand and gravel governance, including the production and consumption of alternative approaches and materials, global, regional/transboundary, sectoral, national and subnational policy domains matter; as do informal rules, structures and processes (following (Bennett & Satterfield, 2018)'s environmental governance framework).
Policy environments	Social, political, historical, and economic factors determine much about policy strategy, decision making, choice, actors and their networks, implementation and performance. As such, many dimensions of policy analysis for both upstream design and downstream evaluation depend on the policy environment that is characterised by these and other factors. (Weimer & Vining, 2017; HM Treasury, 2020; Cairney, 2019). In complex terrains, as is the case for mineral resource governance (Addison & Roe, 2018) and circular economy transitions (van den Bergh, 2020), considering such factors is all the more critical to enhance transparency, understand and reduce policy failures and move towards policy enabling conditions that support pragmatic and positive sustainability transformations (Ansell & Geyer, 2017; Brunswicker et al., 2019; Mueller, 2020).
Policy instruments	A policy instrument is a linkage between policy formulation and policy implementation. They are used by governments to pursue a desired policy outcome. Examples include economic instruments like taxes, incentives, public R&D investment, market creation and public procurement; legislative and regulatory instruments including norm and standard-setting, legal penalties, sanctions; education and research instruments including public awareness raising; voluntary instruments including agreements, public private partnerships; direct service provision; enforcement (Ali, 2013; Cairney, 2019; OECD, n.d.).

Rock	A geological material is a rock when the constituent grains or minerals are bonded and form a solid framework that has tensile strength other than through bonding by water, hydromechanical processes, van der Waals attraction or electrical double-layer repulsion. The two-way transition from unconsolidated accumulations of mineral sediment or soil grains or minerals to rock is gradual. The transition can occur through a variety of physical, chemical, biological, and climatic processes (UNEP/GRID-Geneva 2022).
Sand	Sand is a mineral granular material which does not stick together when wet and remoulded (i.e., non-cohesive) and where the combined weight of 50% of the particles is smaller than 4.75mm, with less than 15% of material smaller than 75μm. For a precise and correct description of sand, secondary qualifiers are needed (UNEP/GRID-Geneva 2022).
Sand extraction	The removal of primary (virgin, natural) sand resources from the natural environment (terrestrial, riverine, lacustrine, coastal, or marine) (UNEP, 2019). Sand can be removed for infrastructure works without the objective of using it as a resource (e.g., the construction of a channel) (UNEP 2022).
Sand mining	The removal of primary (virgin, natural) sand resources from the natural environment (terrestrial, riverine, lacustrine, coastal, or marine) as a resource for subsequent processing or use (UNEP 2022).
Sand resources	An abbreviation used to denote mineral sands, gravel, crushed rock, and aggregates [Also used as: *Global sand resources*]
Sand value chain	The value chain is comprised of all activities that provide and receive value throughout the life cycle of a product or a service, from production to disposal after use, and including aspects such as business models, investments and stakeholders (UNEP, 2021c). The value chain is one framework that supports holistic analysis of materials flows, causes and effects, social and environmental impacts, different actors, problematic practices and potential intervention points (European Commission. et al., 2014; UNEP, 2021c; Linkov et al., 2020). Evaluating what is a responsible sourcing of sand and gravel, as well as alternatives - and extracting insights about how best to achieve this in different contexts - requires an understanding of sustainability impacts for natural resource extraction, use and management in the reality of production and consumption.

Scale / level *[Multi-scale Cross-level]*	"Scale" refers to spatial, temporal, jurisdictional, institutional, management, networks, knowledge scales. "Level" refers to the different units of analysis possible in each of these scales (Cash et al., 2006).
Substitution	The replacement of natural sand resources by other materials including crushed rocks (UNEP, 2019).
Sustainability	Sustainability means transforming our ways of living to maximize the chances that environmental and social conditions will indefinitely support human security, well-being, and health. See discussion on multiple definitions under "Sustainable Development" (UNEP, 2019).
Sustainable development	Sustainable development is commonly defined as development that meets the needs of the present without compromising the ability of future generations to meet their own needs (Brundtland Commission, 1987). However, there are multiple perspectives and definitions of sustainability to be considered (Virtanen et al., 2020). In the construction sector, for example, (Abrahams, 2017: 20) found that the "construction industry construct definitions of sustainable development to valorise their professional role, support professional critiques of the industry or to reinforce their personal ideological beliefs". Thus, definitions of sustainability should be thought about inclusively, as it is often subjective and relative to the context.
Sustainable infrastructure	Sustainable infrastructure is any infrastructure that is planned and designed, constructed, commissioned, operated, decommissioned in manners that ensures economic and financial, social, environmental (including climate resilience), and institutional sustainability over the entire infrastructure lifecycle (UNEP, 2021b). This requires both assessing and addressing environmental and social risks, assuring financial resources to maintain infrastructure over its entire lifespan, considering users' preferences and needs in the design, and understanding the institutional and political dynamics in order to guarantee a long-term perspective. Infrastructure covered under the SuRE sustainable infrastructure standard includes, but is not limited to: • Water (harvesting, storage, management, distribution, treatment and recycling); • Energy (generation, storage and distribution); • Solid waste (collection, distribution, processing, recycling and storage);

	• Transport networks, nodes and fleet (pedestrian, bicycle, vehicular, rail, water-borne and air transportation); • Communication networks (telephone, cellular and data); • Social infrastructure (education, healthcare, sports and recreation, law enforcement, fire and emergency services): • Food systems (production, storage, processing and distribution); • Mining and extractive sites (Global Infrastructure Basel, 2021)
Sustainable sand management	Sustainable resource management means both (a) ensuring that consumption does not exceed levels of sustainable supply and (b) ensuring that the earth's systems are able to perform their natural functions (e.g.that sediment flow in river basins continue. The objective is to ensure the long-term material basis of societies in a way that resource extraction, use, and waste and emissions management do not surpass key thresholds for long-term environmental sustainability and human wellbeing (UNEP, 2019).
Sustainable sand supply	Sustainable supply refers to the amount of resources that can be extracted and used for production and consumption before the threshold of a safe operating space is surpassed (UNEP, 2019).

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