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Mapping soil compaction – A review

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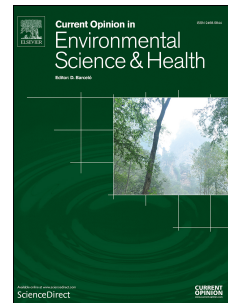
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1 Mapping soil compaction – A review

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8 Abstract

9 Land degradation due to soil compaction is a widespread phenomenon. Delineating maps of
10 topsoil compaction is a challenging task due to its dynamic nature, which is highly variable in
11 time and space. This review paper sheds light on existing approaches and methods of mapping
12 soil compaction. At the plot scale, there are three ways of doing so: (1) Direct measurement of
13 penetration resistance (PR) and electrical conductivity, which can be scaled up using
14 geostatistical approaches or georeferenced data; (2) calculation of vertical stress, taking into
15 account the total load and contact area, soil characteristics, and machine load; and (3)
16 computation of the pre-consolidation stress from pedo-transfer functions based on key soil
17 properties obtained from available databases. At larger scales, indirect relationships are used
18 to predict risk of compaction based on measured values, such as PR values, soil moisture, or
19 organic matter, combined with a cartographic depth-to-water index derived from a light
20 detection and ranging technique or other digital elevation model approaches. Among the
21 examples we provide a 3D mapping based on the TASC (Tyres/Tracks And Soil Compaction)
22 model, which opens new avenues in mapping methodology for helping practitioners, advisers,
23 and policymakers to mitigate soil compaction. Since subsoil compaction can persist over
24 decades, indicating a long memory effect (especially in the case of afforestation), knowledge
25 of previous land uses must be taken into account for mapping areas subject to soil damage.
26 Multi-stakeholder engagement can help to compile this information.

27

28 1. Introduction

29 Land degradation due to soil compaction from agro technical traffic or grazing intensification
30 is a widespread phenomenon. The weight of the machine used in agriculture and forestry has
31 quadrupled in the last 40 years [1]. Some 33 million hectares are affected by soil compaction
32 in Europe [2**]. Of these, 20 million hectares are in Eastern Europe, which amounts to 37.5%

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