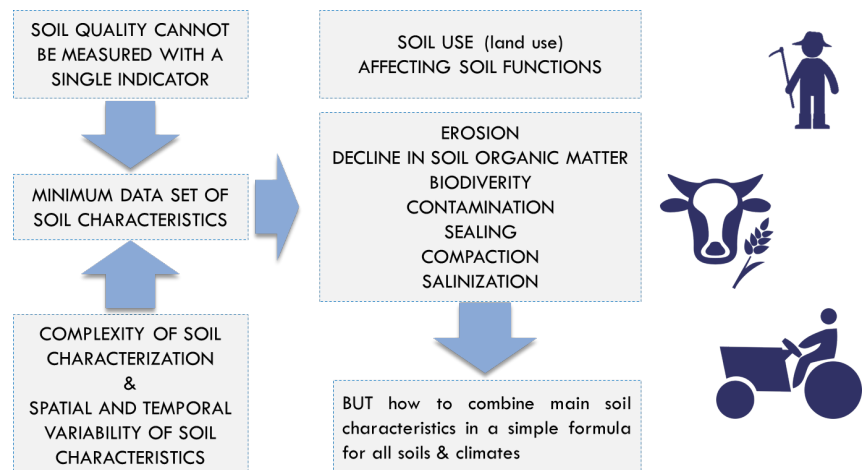


## Soil quality in Life Cycle Assessment

### Soil quality in Life Cycle Assessment

Soil quality, defined as the capacity of a living soil to function, within natural or managed ecosystem boundaries, to sustain plant and animal productivity, maintain or enhance water and air quality, and promote plant and animal health, is recognized as essential for the development of human activities such as food production.

The incorporation of soil quality indicators in Life Cycle Assessment (LCA) is quite recent and is not an easy task. Impacts of land use change in soil quality have not always been considered, mainly due to the challenge of quantifying them and establishing a minimum data set (MDS). The difficulty in quantifying soil quality in LCA is also based on its dynamic



**Figure 1.** Difficulties in assessing potential impacts on soil quality in LCA.

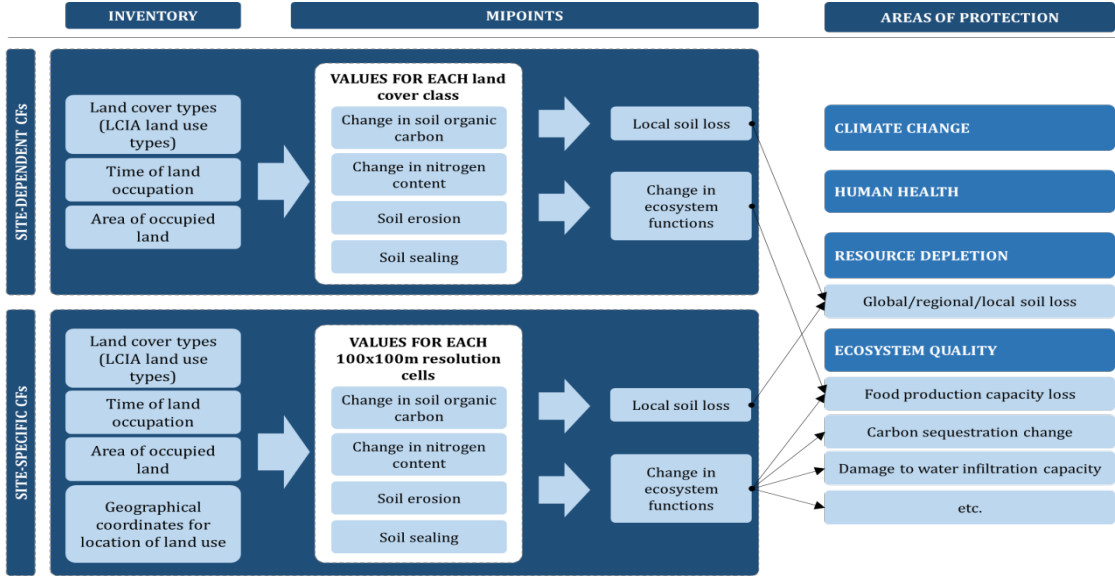
conditions, both in time and space (**Figure 1**). Moreover, different environmental conditions and management practices may alter the conditions of soil quality, depending also on the soil type. However, this is a challenging task in LCA, due to the limitations in life cycle inventory.

### SoilTrEC characterization factors for soil quality in LCA

Characterization factors (CFs) in LCA are in general proposed based in a *top-down* approach, i.e., with generic information produced for a more global context (or mostly European). However, for many cases, such as with soil quality, these factors do not fully represent local and/or regional impacts and damages to the environment. The SoilTrEC project provided the possibility to propose CFs following a *bottom-up* approach, in which data is provided in a local scale, allowing a much more accurate representation of soil quality in a local and regional context (in this case, Crete Island). Site-specific and site-dependent characterization factors have been proposed for Crete Island, where data from the SoilTrEC data on Koiliaris watershed was up-scaled to the entire island.

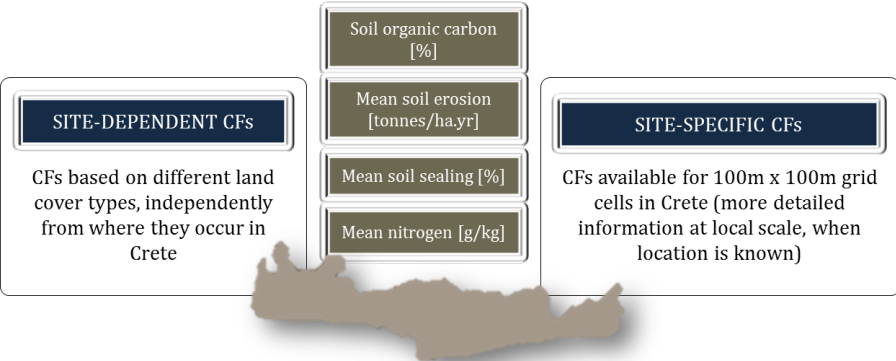
Following the current development of soil quality indicators in LCA and the belief that a multi-indicator is a better way to express soil quality, SoilTrEC proposed a multi-indicator, containing four parameters (**Figure 2**). The multi-indicator contains information, for different land cover

types (and Corine levels I, II and III) in Crete, on (1) mean soil organic carbon [%]; (2) mean soil erosion [tons/ha.yr]; (3) mean nitrogen content [g/kg]; and (4) mean soil sealing [%].



**Figure 2.** Schematic representation of the environmental mechanism from inventory data required up to representation of possible end-points. The scheme presents the environmental mechanism for both site-dependent and site-specific characterization factors (for occupation).

The LCA midpoint characterization factors were proposed for Crete in two different levels. The first level is called “*site-dependent characterization factors*”, and they indicate the impact of “occupation” in different land cover types – independently from where they are located in Crete. They are especially useful when a LCA practitioner does not know the exact location of the product system, but can inform about the land use in which the activity takes place. These factors are commonly used in LCA practice. The second level of CFs is called “*site-specific characterization factors*” and they indicate the impact of occupation – taking into account the four parameters - for each 100x100 m resolution grid cells throughout whole Crete. The raster database contains 86.455 cells and every single cell is assigned a set of values with the four specified soil quality parameters (Figure 3).



**Figure 3.** Site dependent and site-specific characterization factors were proposed for Crete island, based in four different soil quality parameters: (i) soil organic carbon, (ii) mean soil erosion, (iii) mean nitrogen, and (iv) mean soil sealing.

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