Crucial aspects of phosphorus recovery from sewage sludge in context of climate change

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Recent accelerated climate change and rising temperatures are excelling existing environmental problems in the Mediterranean Basin that are caused by the combination of changes in land use, increasing pollution and declining biodiversity. In most impact domains (such as water, ecosystems, food, health and security), current changes and future scenarios consistently point to significant and increasing risks during the coming decades. In the Mediterranean region, average annual temperatures are now approximately 1.5°C higher than during the period 1880-2019 (Fig.1), well above current global warming trends [1].

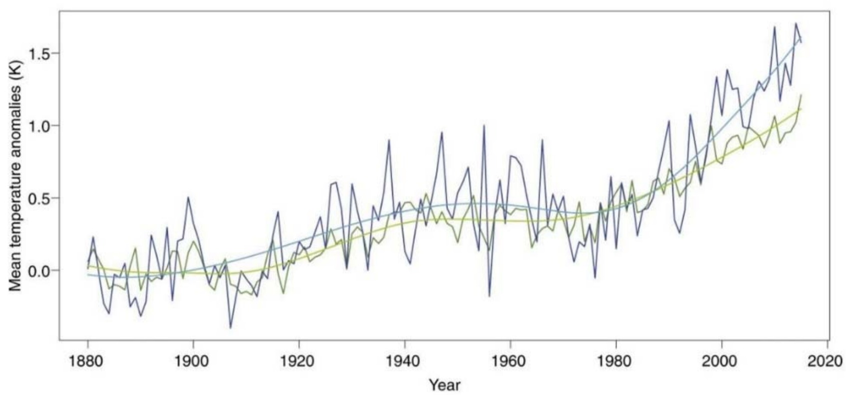

Fig. 1. average annual temperatures during the period 1880-2019

Warming of the atmosphere (annual mean temperature anomalies with respect to the period 1880-2019), in the Mediterranean Basin (blue lines, with and without smoothing) and for the globe (green line). Policies for the sustainable development of Mediterranean countries need to mitigate these risks. Studies suggest that 30% of semiarid Mediterranean drylands (Fig. 2) are affected by desertification and that 47% of the region’s people suffer these effects [2].

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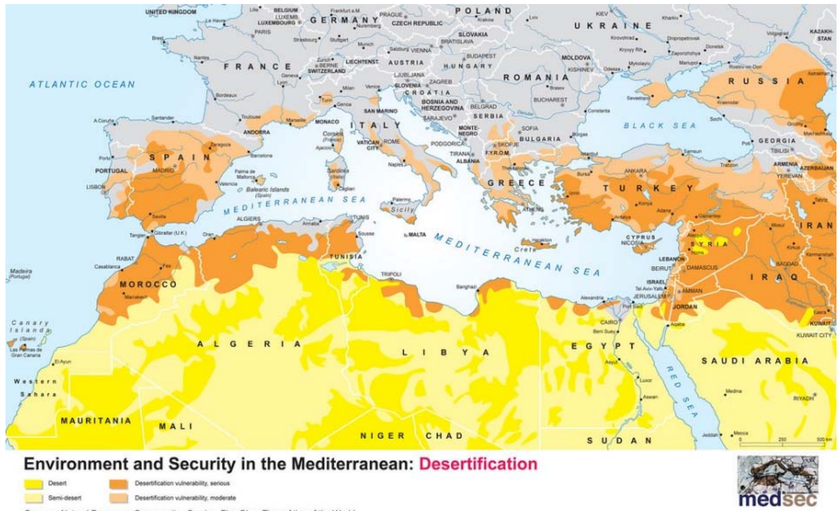

Fig 2. Environment and Security in the Mediterranean: Desertification

Soil degradation affects more than one billion people worldwide, particularly in dry regions, where around 40% of the world population live. Soil degradation is indicated mainly by a loss of soil functions, a large portion of which depends on soil aggregation and soil organic matter (SOM) storage within aggregates. The provision of microbial substrate by compost and of habitat by biochar are central in sustainable soil amelioration. A new field of biochar and compost application is the large-scale rehabilitation of degraded soils to restore their functions and to enable sustainable use over the long term [3]. Biochar addition in soils increases besides other eligible effects water use efficiency and plant available soil water [4].

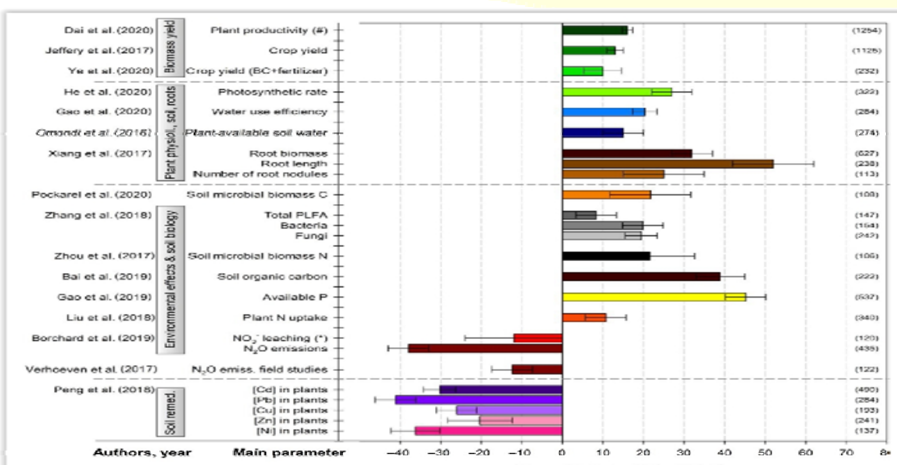

Fig. 3. Main parameters of soil and effect sizes presented in the literature

Emissions reduction alone is no longer sufficient to contain the climate crisis. In parallel with the reduction of emissions, a start must now be made on expanding and further developing the existing options for creating carbon sinks (Fig.4). The magnitude of the task is enormous: In order to achieve climate neutrality in the European Union, the volume of sinks to be created annually must increase to at least 850 million tonnes of CO_2 by the year 2050 [5].

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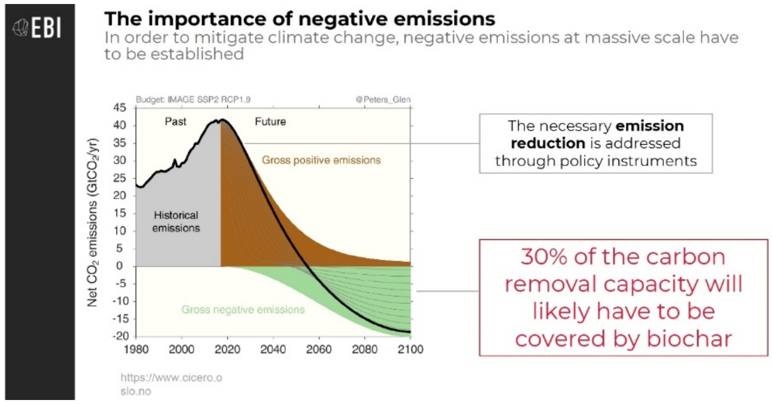

Fig.4. Negative emission as a key factor for mitigation of climate changes

Biomass pyrolysis and agricultural use of the biochar is thus a key technology for saving the climate. Biochar has been intensively researched in recent years. A wealth of experience with its applications and innumerable scientific publications prove today that in addition to its direct climate benefit as a carbon sink, biochar can be used in agriculture in many profitable and beneficial ways. Besides the carbon sink effect, sewage sludge biochar delivers a highly valuable phosphorus source with a high P recovery rate [6].

Global warming potential (GWP) of different fertilizers

The 2019 study by the German Federal Environmental Agency [6] showed that conventional fertilizer production in Germany emits about +1.2 kg CO_2 eq /kg P_2O_5. Furthermore, phosphate recovery processes like precipitation (in digested sludge or centrate) or sewage sludge ash also demonstrably cause CO_2 emissions. Using the same calculation methodology in comparison to the global warming potential (GWP) of these processes, PYREG biochar from sewage sludge has a negative GWP of -4,01 kg CO_2 eq /kg P_2O_5 (Fig. 5). Consequently, the recovery of phosphate within the PYREG process and the final application of the biochar contributes to fight global warming, increase water use efficiency and reaching net zero.

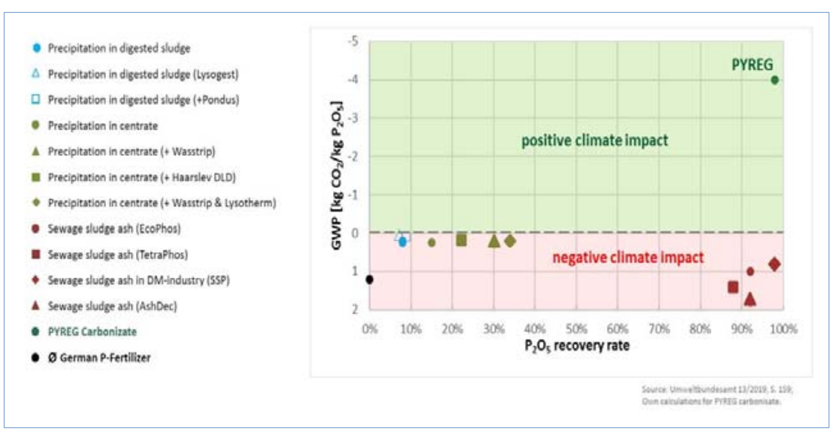

Fig. 5. GWP of PYREG biochar

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