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Nature-based solutions in brook catchments: Modelling land-use change and its impact on terrestrial carbon pools (1960 – 2010 – 2050).

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Nature-based solutions (NbS) in brook catchments are considered as climate measures to adapt to hydro-meteorological extremes (storms, floods, droughts) and human-induced water demand. These NbS, often wetlands at multiple scales, cause land-use change (LUC), e.g., from cropland into wetland. Furthermore, LUC is also caused by other anthropogenic reasons (e.g., urbanization, channeling).

To improve this modelling by incorporating multi-scale spatial and temporal aspects, earlier studies modelled LUC and carbon pools, but did this without a regional focus on the impact of NbS. A system analysis of a brook catchment (Dutch Aa/Weerijs; 147 km^2; S of Breda) determines the spatio-temporal dynamics of LUC and its connection to carbon pools including the climate mitigation impact of NbS. The question arises if ready-to-use tools can help to connect the associated spatio-temporal datasets, to support professionals in regional development on rapid appraisal of carbon pool dynamics and impacts of NbS.

Firstly, in a pilot study, a system analysis of LUC and temporal carbon pool data has been developed on open access datasets (e.g., open topo and land registry). To get an outlook for 2050, 1960 was taken as a starting point because the brook catchment, including the brook itself, transformed just after 1960. To determine historic spatio-temporal dynamics of LUC and carbon pools, 2010 was chosen. Then, the landscape is predicted for 2050 in two scenarios: A Technical/physical scenario (in which a business-as-usual situation is considered) and a NbS/Wetlands scenario which focusses on NbS and in particular on wetlands. Four terrestrial carbon pools within seven land-use categories have been used. Land-use classification for 1960 and 2010 has been done with topographic maps and ArcGIS. Land-use prediction for 2050 has been done with a Land Change Modeler (TerrSet2020, ClarkLabs) with land-use from 1960 and 2010 as input data.

Secondly, the results of the pilot study have been validated by a field visit and regional professionals with expertise on LUC and carbon pools. As a third step, the updated, validated method has been applied to the whole Dutch catchment.

Findings indicate that 40 km^2 (≈ 27%) transformed between 1960 and 2010 with an impact on

terrestrial carbon of + 0.5 Mton (≈ +50% change: 1 Mton in 1960 and 1.5 Mton in 2010). Findings for 2050 are:

- For the Technical-physical scenario a minor increase of terrestrial carbon. This will probably be explained by settlement expansion and by the increase areal of tree nursery. Tree nursery is especially a land-use category that emerges in the study area.
- For the NbS/Wetlands scenario, which emphasizes wetlands as nature-based solutions, a major increase of terrestrial carbon. This is explained by the increase of the areal of wetlands.

In this study we presented an approach where a combination of tools - a land change modeler and ArcGIS - can be used for a rapid assessment of mitigating effects on climate adaptation measures. This offers water professionals the opportunity to meet the many challenges on NbS in brook/river basins.