

POPULAR SCIENTIFIC SUMMARY OF PROJECT: The use of carbon footprint as a part of environmental carrying capacity assessment for more sustainable spatial management

2 billions hectares of area is degraded by humans, which is the result of spatial planning decisions that do not recognize and take into account uneconomic functions of ecosystems and their biophysical limits. The environmental pressures will be even greater, which is associated with an increase of urban populations and its growing demand for natural resources. Therefore, the urban ecosystem capacities should be assessed and included into planning and urban development. Cities cannot be sustainable if the ecological resources on which they depend are excluded from spatial analysis and policy. There is a need to implement the idea of *environmental carrying capacity* (ECC) into the process of spatial management in cities. The ECC allows for quantification of the state of the environment, which is important, especially nowadays when we are facing with the global environmental change.

Therefore, this research project is to provide an answer to the problem of irrational spatial management. The aim of the project is to create a decision support tool for integrated spatial management at the local level, with particular emphasis on environmental limits to growth using ECC assessment. The main goal will be achieved by adapting to the local level the existing methodology of estimating carbon footprint (CF) and its implementation for ECC assessment. The CF reflects the carbon dioxide equivalent connected with the resource exploitation and waste generation by human population.

The CF would be assessed for few categories as: (1) *food*, (2) *housing* and (3) *mobility*, and assigned to them components as: *food consumption, food waste; sewage generation, garbage generation, water use, electricity use, gas use; public transport - ridership of buses and trams and private transport - car use*. In each case, the resource use or waste generation will be converted into corresponding to it carbon dioxide equivalent (CO_{2eq}) and then into biological area need to sequestrate it. The assessment would be conducted for 16 voivodship cities.

The CF could be compared with biocapacity (BC), representing the natural areas, which provides ecosystem services as carbon dioxide sequestration. The difference between BC and CF indicates the level of exploitation of the environment. There could be quantified three states of the environment: (1) when $BC > CF$ - *ecological limit*, (2) $BC < CF$ - *ecological deficit*, (3) $CF / BC \leq 1$ - *environmental sustainability*, with the assumption that 11% of natural resources are the minimum that must be preserved for the regeneration of biodiversity. The comparison between CF and BC would allow to identify cities as *ecological debtors* ($CF > BC$) or *ecological creditors* ($BC > CF$). Moreover, the research would provide the data about the CF per capita, which is one of the basic information to verify how many 'Earths' would be required if all population will live like average inhabitant of city recognized as ecological debtor.

The approach would be supplemented by local data acquisition, which is especially important in case of food consumption and current lack of appropriate dataset. Moreover, taking into account that ECC should be a decision support tool for spatial management and strategic documents creating, the research will include the implemented and planned green solutions (as green and blue infrastructure) by municipality. It would allow to quantify the extent to which the use of such solutions could minimize human impact on the environment. The results could provide an input for preparing local environmental action-plan by municipality.

The research fits into the latest discussion connected with "climate emergency" state and the need for enhancing the current state of the environment. Moreover, recent studies indicate that all contemporary socio-environmental problems could be associated with the consequences of infinite growth on a finite planet, thus there is a the need for assessment and living within the environmental limits.