ENVIRONMENTAL IMPACT ON THE USE OF MINE SOILS FOR EXTRACTING CERAMIC RAW MATERIALS IN THE LIFE CYCLE ANALYSIS FRAMEWORK

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1. INTRODUCTION: LCA AND SOIL USE

One of the most widely accepted tools by the scientific community for assessing environmental impact is Life Cycle Analysis (LCA) which studies the environmental aspects and potential impacts throughout the life cycle of a product or an activity. Through this method, the composition and the amounts of pollutants created and resources consumed can be assessed in terms of their impacts on the environment by grouping them into a small number of environmental categories.

The impact categories most often selected in the LCAs tend to be: the greenhouse effect or global warming, the ozone layer depletion, acidification, eutrophication, energy consumption, etc. However, there are others to which less importance is attached or which are not directly taken into account when an environmental analysis is being carried out. A clear example of a category that has been rather undeveloped and applied in the LCA field is that of the soil use.

Soil use is the main direct cause of many production system impacts. The mining activity that most affects the environment is surface or open sky exploitation. At the present day, the development and application of environmental impact indicators set in this category is an arduous and complex task, since there is a great lack of definition regarding the parameters to be considered, for reliable methodologies have not yet been developed to allow them to be assessed.

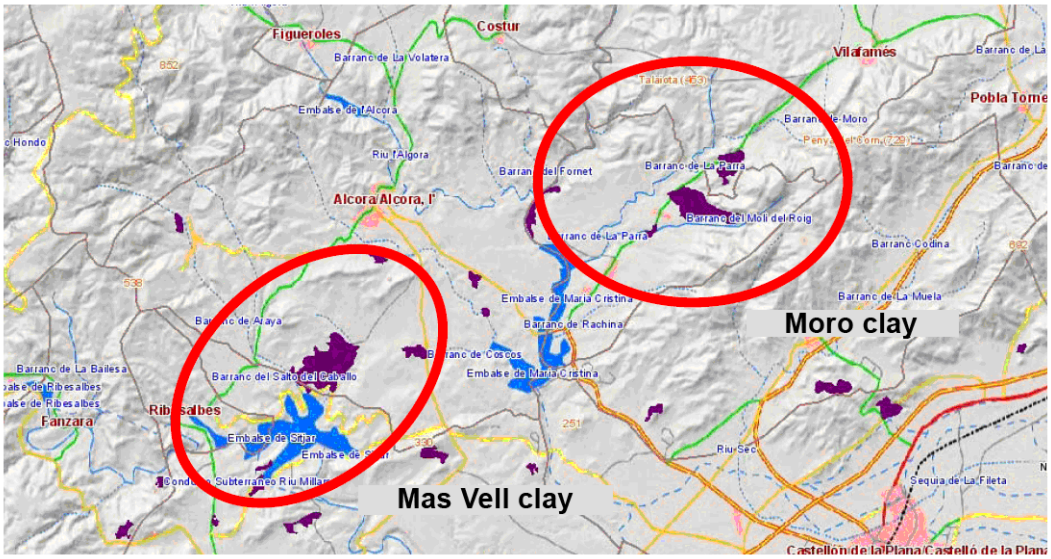

Figure 1. Study areas considered for assessing the impact of soil use.

2. METHODOLOGICAL DEVELOPMENT

In his doctoral thesis, Garrain (2009) developed a methodology that allows the environmental impacts on any potential transformation in soil use to be assessed. To do so, he firstly identified the main impacts caused on the transformation of a given region by selecting the effects on biodiversity, fertility of the land, and on the

landscape as the most important ones. The methodology developed is based on relativizing these impacts by using the so-called Analytic Hierarchy Process (AHP) multi-criterion decision technique.

In this study, based on this methodology and as a first approach, it is intended to assess the environmental impact caused by mines used for extracting clays for producing ceramic floor and wall tiles with respect to the soil use category within the LCA framework (figure 1).

In order to calculate the total impact, these steps have been followed: i) Characterisation of the study areas according to their vegetation and richness of the soil, ii) Application of the most referenced methods on the extent of the impact on biodiversity, the vital support functions or fertility, and on the landscape to obtain the impact indicators, iii) Scaling the values of the impact indicators from 0 to 10, iv) Applying the AHP multi-criterion method to relativize and weigh the chosen impacts, v) Lastly, applying the calculated weights of the application of the AHP method to the values obtained for each impact in order to obtain the general impact rate with a weighted scale of 0 to 10.

3. RESULTS

After the application of these stages, the unique value is shown in the following table:

Impac on	Methodology	Weighted value	AHP Value	Subtotal
Biodiversity	Köllner (2000)	-6.11	0.649	-3.966
Fertility	Lindeijer (2000)	-6.20	0.244	-0.538
Landscape	Otero et al. (2007)	-6.50	0.107	-0.696
			TOTAL	**-5.199**

Table 1. Weighted values of the indicators of the impact of the use of soil and total weighted value of the transformation of Iberian wooded land into a clay mine.

4. CONCLUSIONS

The methodology for finding this value is valid for making comparisons between adopting to transform one type of soil into another different one and the possibility of placing a certain type of land or other in a given place. The calculation of the total impact gives the result of a dimensionless positive or negative value between 0 and 10, depending on the impact, which is valid for this type of comparisons. This result, which corresponds to the change of a certain type of land into another, only gives an idea of the impact in percentage terms.

REFERENCES

[1] Garraín, D. (2009): "Desarrollo y aplicación de las categorías de impacto ambiental de ruido y de uso de suelo en la metodología de análisis de ciclo de vida", PhD dissertation, Universitat Jaume I, Castellón.

[2] Köllner, T. (2000) "Species-pool effect potentials (SPEP) as a yardstick to evaluate land-use impacts on biodiversity", Journal of Cleaner Production, 8, pp. 293-311.

[3] Lindeijer E. (2000) "Biodiversity and life support impacts of land use in LCA", Journal of Cleaner Production 8, pp. 313-319.

[4] Otero, I., Mancebo, S., Ortega, E., Casermeiro, M. Á. (2007) "Mapping landscape quality in Spain", M+A Revista Electrónic@ de Medioambiente, 4, pp. 18-34.