



Criticality methodology for resources: how to apply to construction in the future?

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Motivation for the research



<http://coastalcare.org/2013/09/sand-thieves-are-eroding-worlds-beaches-for-castles-of-cash-2/>

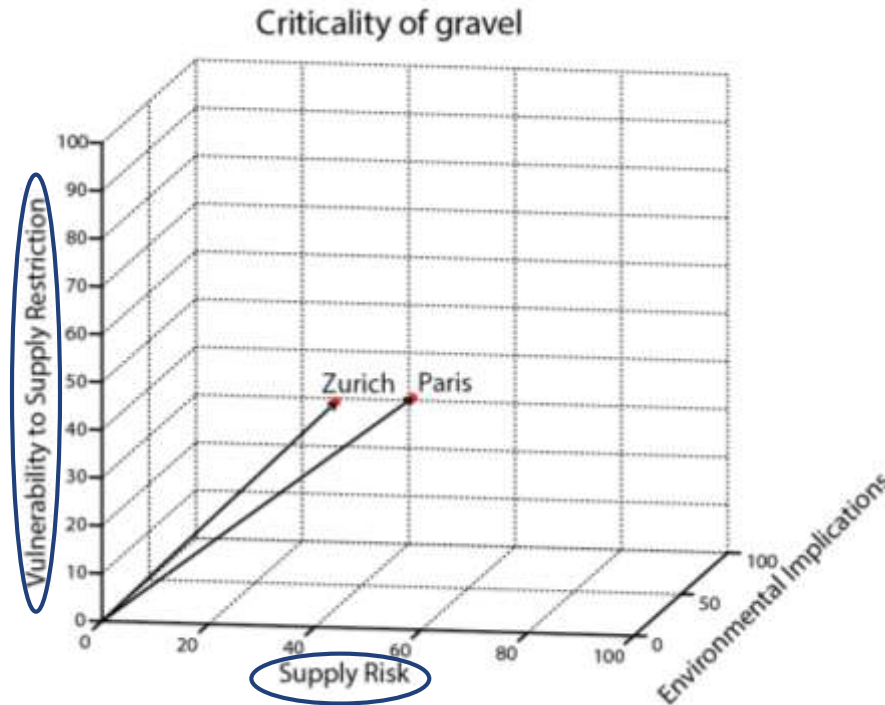
Motivation for the research

- Construction: 40% of global resources (UNEP, 2014)
- Local supply constraint → Stone reserves infinite globally, but locally risk of depletion
- Current LCA Abiotic Depletion Indicators cannot express this issue
- Criticality methodologies integrate socio-economic and geopolitical aspects as well as environmental impacts.

Objective of the study: apply criticality to construction resources

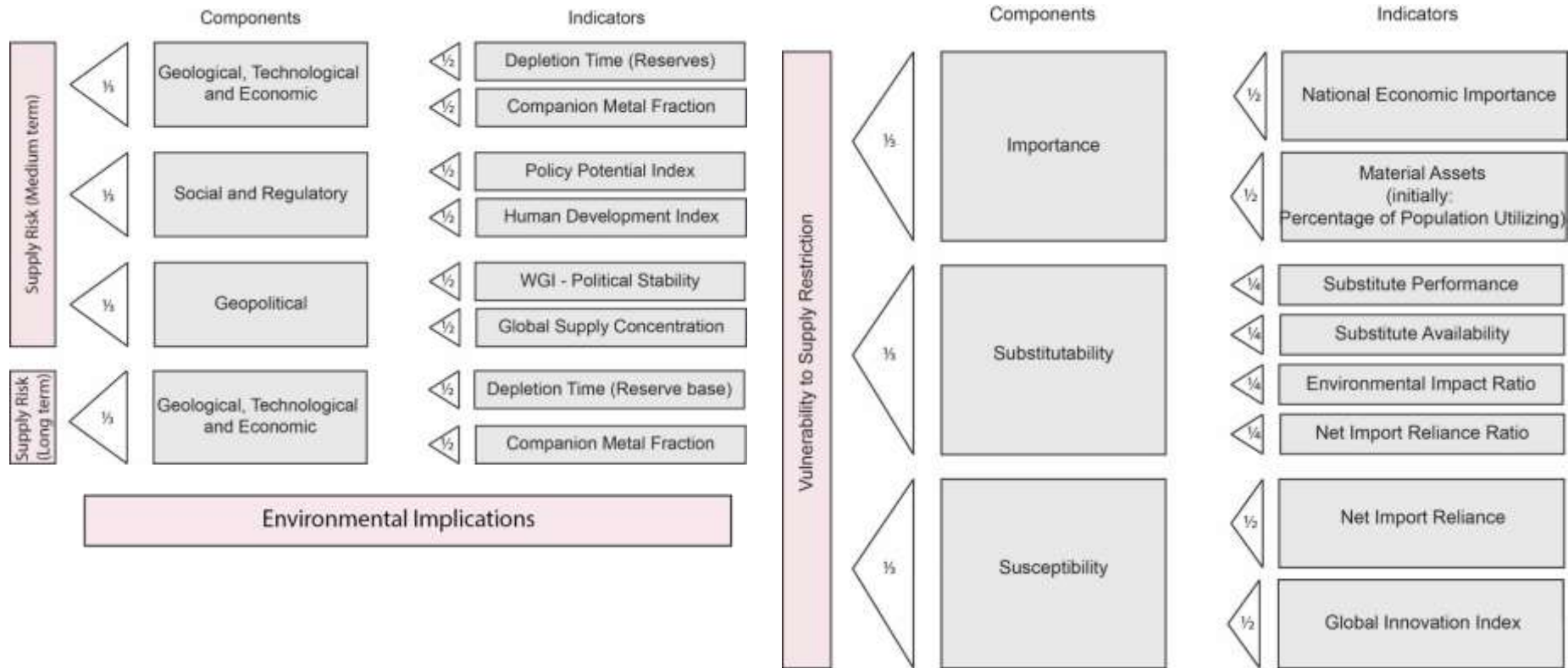
What is criticality?

High
impact of
shortage
of a
resource



High probability of
such a shortage

Criticality methodology



Graedel, T.E., Barr, R., Chandler, C., Chase, T., Choi, J., Christoffersen, L., Friedlander, E., Henly, C., Jun, C., Nassar, N.T., Schechner, D., Warren, S., Yang, M.-y., Zhu, C., 2012. Methodology of Metal Criticality Determination. Environ Sci Technol 46, 1063-70.

Application of methodology to gravel

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Full length article

Is gravel becoming scarce? Evaluating the local criticality of construction aggregates



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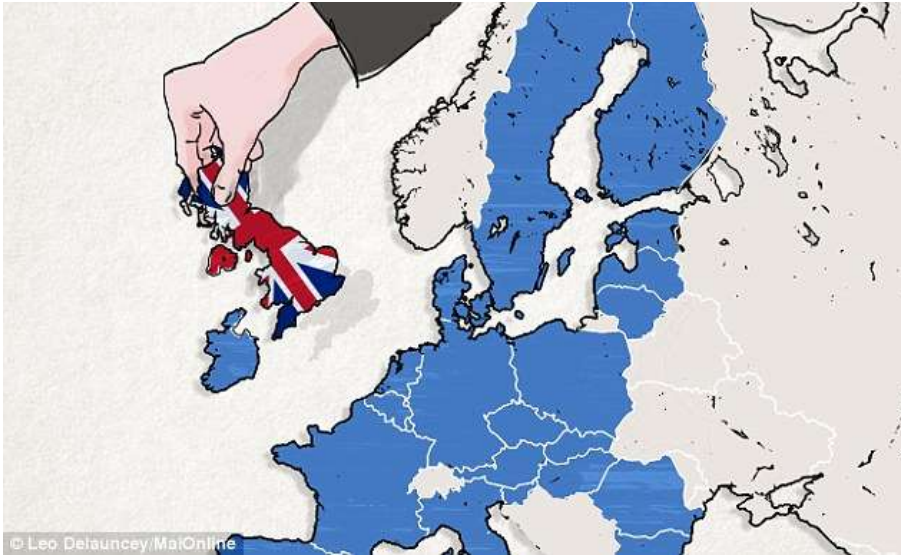
Keywords:
Aggregates
Criticality
Supply risk
Locality

ABSTRACT

Natural aggregates are considered an immense natural resource at the global level; however some regions face a supply constraint due to the overexploitation of natural aggregates in construction. This paper presents an assessment of the local criticality of quarried aggregates by adapting the methodology for metal criticality determination to the characteristics of construction aggregates. Two approaches, strong and weak locality, are envisaged to examine different substitution scenarios in the case of local supply constraint. The adapted methodology examines three dimensions: Supply Risk, Environmental Implications and Vulnerability to Supply Restriction. The application of the methodology to the cantons of Switzerland shows that inside a country, the criticality is driven by the Supply Risk, which depends on the surface and number of quarries and their distribution in the region. A comparison of the supply risk of aggregates with the supply risk of steel shows that for most of the cantons the supply risk of natural aggregates is lower. The application of this methodology at a world scale will indicate highly critical regions and enable policymakers to define measures for ensuring a sustainable growth, either by regulating the extraction of aggregates or by demonstrating the local need to consider the use of other materials, apart from concrete.



Strong – weak locality



strong locality

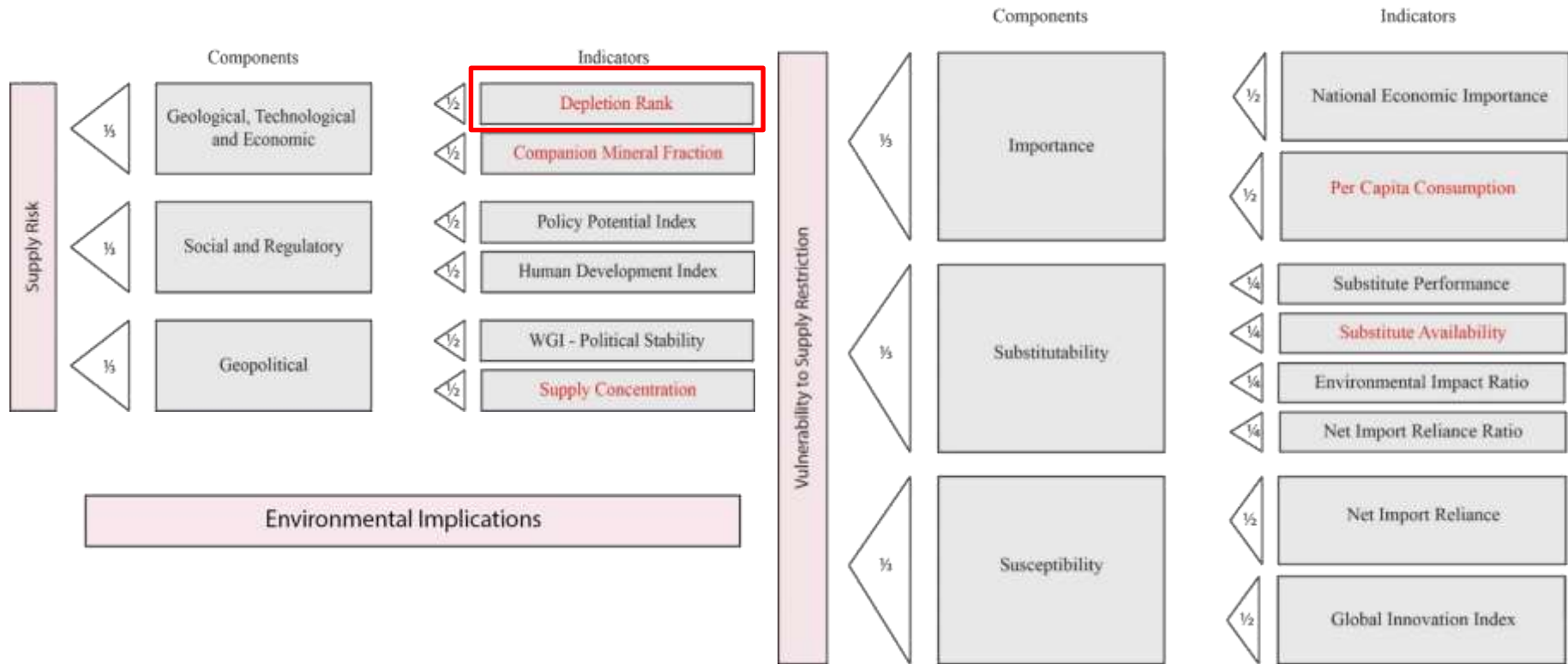
- making use only of the local resources
- self-sufficient economy
- importation is limited



weak locality

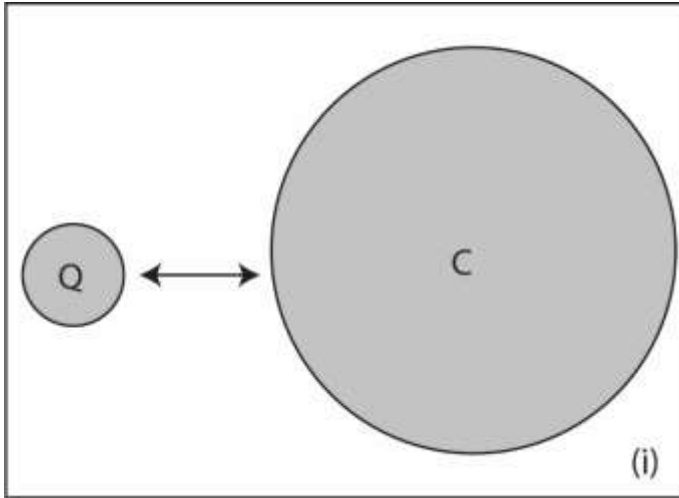
- open & globalized economy
- resources that face a supply constraint at a local level can be imported

Adaptation of indicators to gravel



Adapted from: Graedel, T.E., Barr, R., Chandler, C., Chase, T., Choi, J., Christoffersen, L., Friedlander, E., Henly, C., Jun, C., Nassar, N.T., Schechner, D., Warren, S., Yang, M.-y., Zhu, C., 2012. Methodology of Metal Criticality Determination. Environ Sci Technol 46, 1063-70.

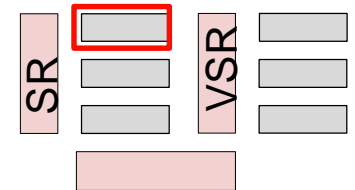
Indicator for depletion of gravel



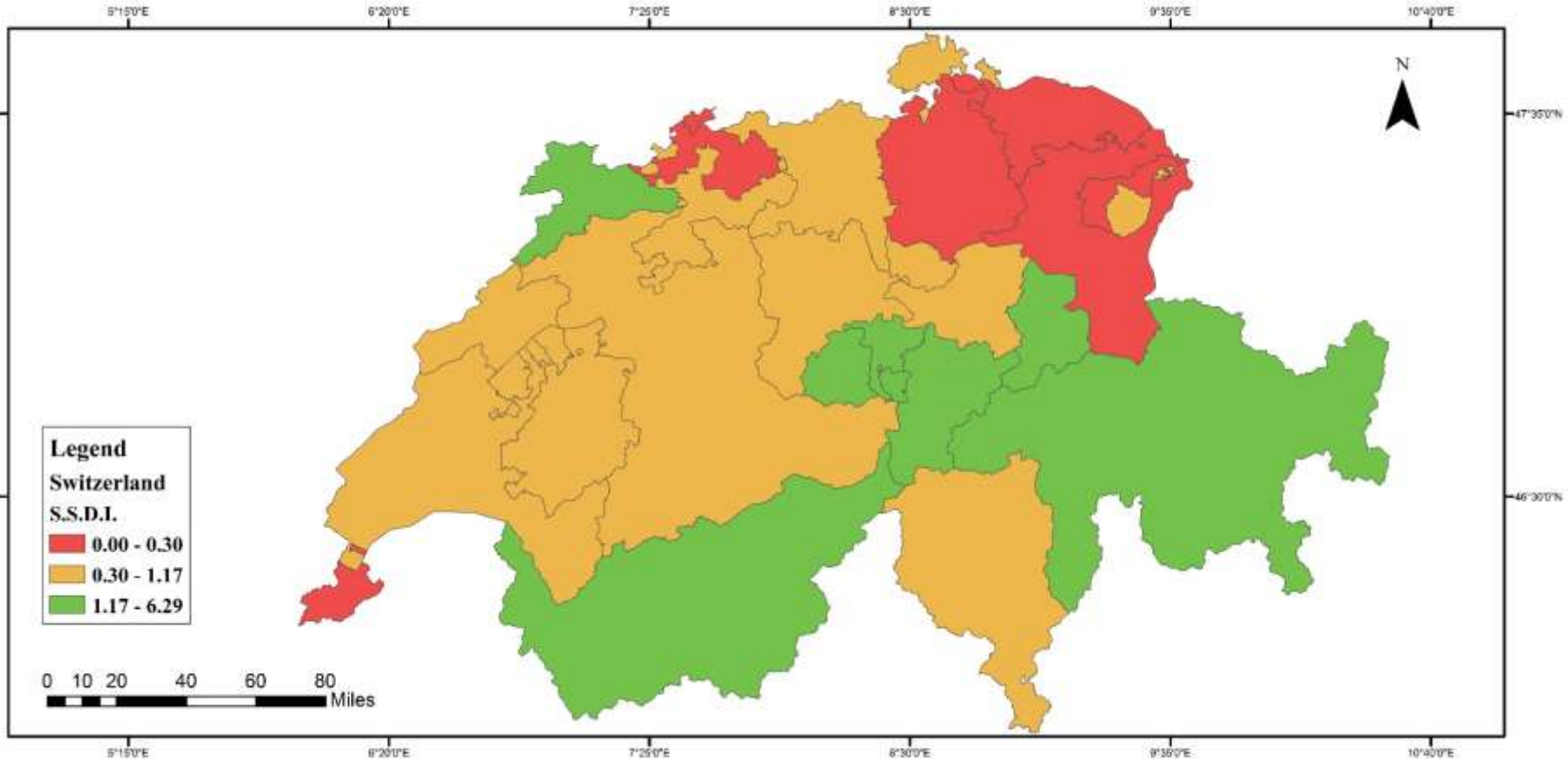
- Assumption:
 - Land competition between quarry and city
 - Not In My Back Yard Effect
- For a canton/department:

$$SSDI = \frac{S_{Quarry}}{S_{City}^2} * S_{Territory}$$

D. Ioannidou, V. Nikias, R. Briere, S. Zerbi, G. Habert. 2015. Land-cover-based indicator to assess the accessibility of resources used in the construction sector. Resour Conserv Recy 94: 80-91

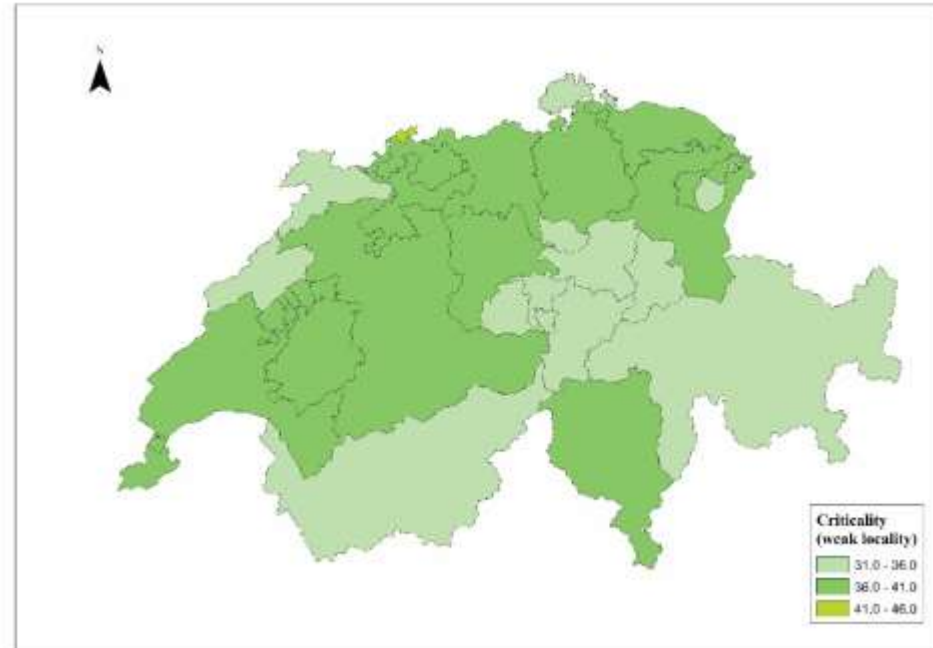
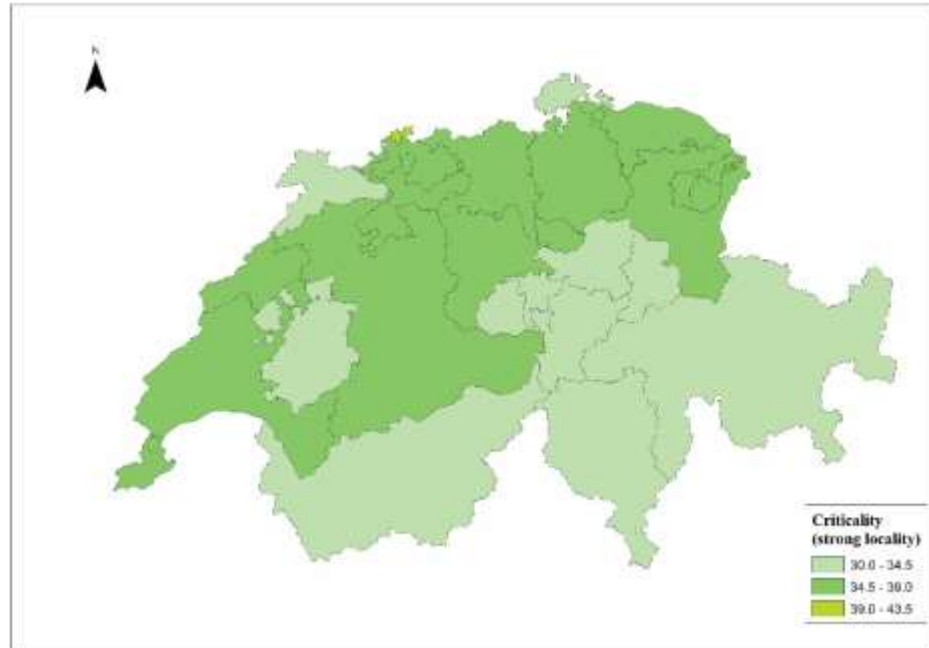


Indicator for depletion of gravel - CH



D. Ioannidou, V. Nikias, R. Briere, S. Zerbi, G. Habert. 2015. Land-cover-based indicator to assess the accessibility of resources used in the construction sector. *Resour Conserv Recy* 94: 80-91

Criticality of gravel - CH



Gravel more critical in the region Swiss Plateau, which contains the biggest Swiss cities.

D. Ioannidou, G. Meylan, G. Sonnemann, G. Habert. 2017. Is gravel becoming scarce? Evaluating the local criticality of construction aggregates. Resour Conserv Recy 126: 25-33

Application of methodology to wood

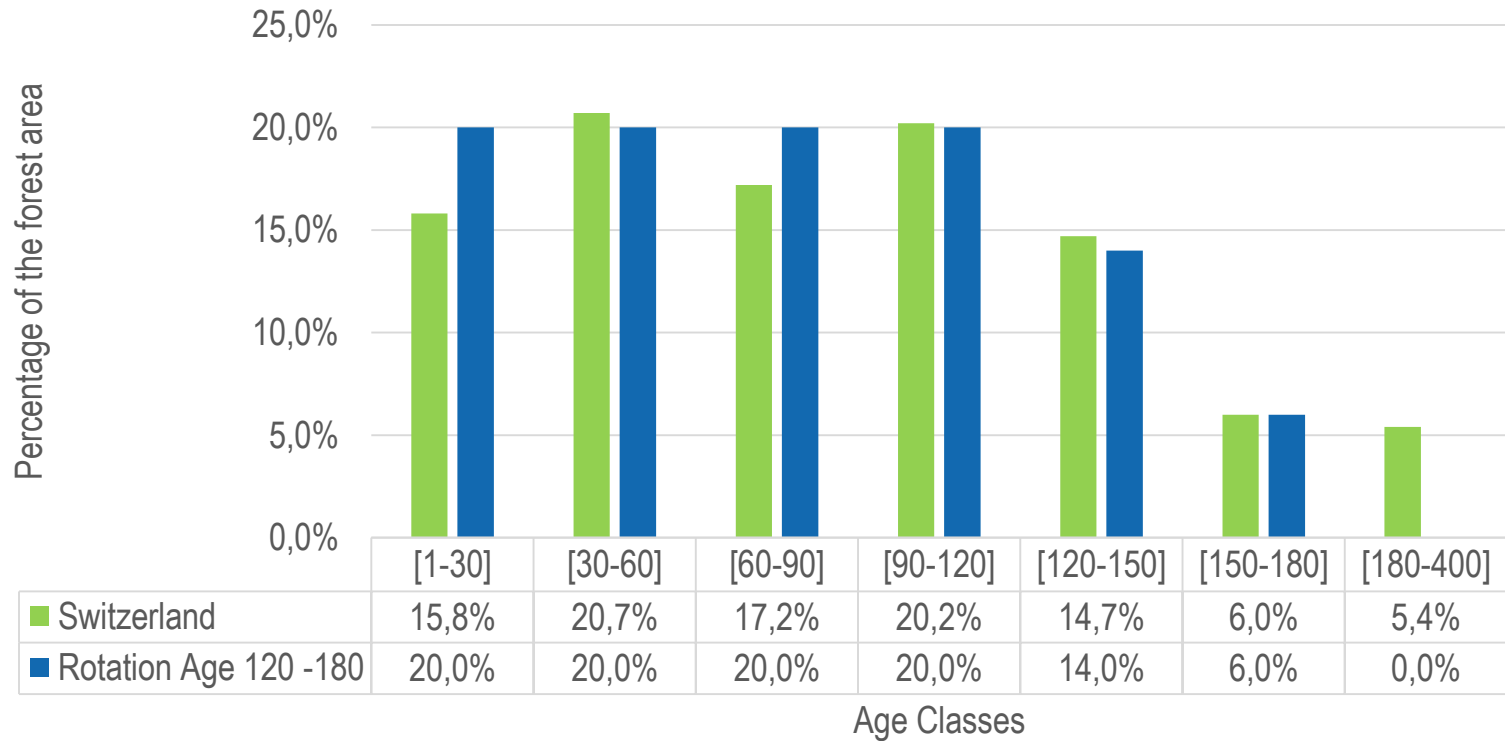
Investigation of the depletion of wood resources



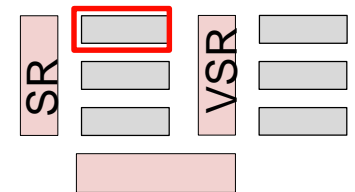
https://www.alibaba.com/product-detail/Ash-Log_124846199.html

Depletion of wood – Available stock

Actual vs Ideal Age Distribution



M. Daldini, G. Zinas. 2016. Can the wood stock cover the construction demand? Development of an indicator to evaluate the Supply Risk of wood under different scenarios. ETH Zurich



Conclusions

- Specifics of construction materials crucial in criticality assessments
- Assessment of construction resources at a regional level
- Accessibility at a local level more important than availability due to socio-economic factors
- The criticality assessment of different construction resources can support decision-making.

Thank you for your attention!!

