Regulatory Compliance and Climate Resilience in Coffee Supply Chains

Problem description

European coffee buyers face new environmental due-diligence requirements. The EU Deforestation Regulation requires them to demonstrate that coffee is legally produced and deforestation-free, supported by traceability to production plots. Buyers can respond by shifting purchases toward suppliers with established compliance systems or by helping existing suppliers meet the requirements and continuing to source from them.

The first response may be easier, but it changes where Europe's coffee comes from. Coffee-producing regions are exposed to drought, heat, and frost, and these hazards can affect several origins in the same year. A sourcing shift may therefore increase or reduce exposure to supply disruptions. An origin that appears less vulnerable individually may still increase overall supply risk if its adverse climate conditions coincide with those affecting other origins.

This thesis investigates how alternative sourcing responses to environmental due-diligence requirements affect the climate resilience of European coffee imports. It will explore:

- How exposed is Europe's current coffee sourcing to climate hazards that affect several producing origins simultaneously?
- Under which conditions does shifting procurement toward origins with stronger compliance readiness increase or reduce climate-related supply risks?
- When is investing in continued access to existing suppliers more cost-effective than switching to alternative origins?

The research will use historical trade, production, and climate data to evaluate alternative sourcing scenarios.

Thesis assignment

The assignment will consist of:

- A literature review on environmental due-diligence regulation, sourcing decisions, and climate resilience in agricultural supply chains.
- Construction of Europe's coffee import portfolio by producing origin using publicly available trade and production data, including estimation of coffee-type shares where these are not directly reported.
- Analysis of historical climate hazards in coffee-producing regions, including the frequency and dependence of simultaneous disruptions across origins.
- Development of sourcing scenarios reflecting different compliance-readiness conditions, with realistic limits on alternative supply capacities.
- Comparison of sourcing scenarios in terms of geographic concentration, correlated climate exposure, and estimated supply-shortfall risk.
- Estimation of the break-even cost of maintaining access to existing origins compared with switching suppliers, including sensitivity analysis of climate risks, sourcing costs, and compliance-support assumptions.
- As a possible extension, development of a small sourcing optimization model for a representative coffee importer.

Student background

The project suits a student interested in supply chain resilience, sustainability policy, and quantitative analysis. Experience with Python and data analysis is expected. Knowledge of statistics, geographic data analysis, or mathematical optimization is an advantage. The research team will support the student in learning the required methods.

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Research setting ReSolVe Project, ORβIT Lab, TU Delft
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