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Inland waterway transport

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Forecasting the impacts of climate change on inland waterways

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Inland waterways are vulnerable to climate change due to their dependence on water levels, which can be affected by droughts or flooding. Reduced water levels can disrupt inland navigation to the point that they are completely non-navigable. The paper summarised in this article analysed the impact of climate change on water levels to forecast the economic impact it may have on inland waterways transport. The study's analyses showed a decrease in the number of days with low water, resulting in an overall economic benefit for inland waterways from climate change.

Inland waterways (IWW) play a significant role in Europe's freight transport system. IWW freight activity between European Union (EU) Member States is only slightly lower than that for rail freight activity and about one-third of that for road freight activity. Although IWW are considered reliable, they have limited flexibility and can be adversely affected by extreme weather events. For example, there are lower and upper water level limits between which IWW transport can operate. Therefore, floods or droughts can adversely affect the water level, so limiting inland navigation. Other impacts of extreme weather that could affect IWW include stronger currents and ice formation.

Droughts present the most significant disruption to IWW navigation because vessels have to reduce their loads and the water level may be reduced to a point that makes IWW entirely non-navigable. Reducing the amount of load carried will result in an increasing number of vessels operating on IWW to compensate for this reduction. Alternatively, some load may shift to road or rail transport.

Increasing the number of vessels and shifting to road transport will increase the carbon emissions per tonne of cargo transported, resulting in an adverse effect on the environment.

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The aim of this study was to assess the economic implications of climate change on IWW transport. The study focused on four ports on the Rhine and the Danube (Wildunsmauer, Hofkirchen, Ruhrort and Kaub), which were selected due to their importance as freight nodes in the European IWW network.

Water levels are related to discharges and riverbed morphology. Projections of future discharges were developed based on different long-term climate models. Information about daily discharge levels and their impact on water levels was used to determine critical discharge levels. This enabled the study to estimate the future yearly distribution of water levels and to determine how each type of vessel will be affected. By comparing this to the historical distribution, the research was able to estimate the relative cost or benefit of climate change for each type of vessel. These estimates can provide important insights for policy makers to aid their decision-making on relevant investments in the freight systems.

To estimate the economic impacts of low water levels, the analysis first calculated the number of days with discharge levels that correspond to a specific level of operation in the IWW system. The results showed that there will be a decreasing number of days with lower water levels and an increasing number of days with higher water levels from now until 2100. Therefore, the projections indicate that the IWW network will operate with fewer disruptions in the future.

Low water levels reduce the navigability and cargo capacity of vessels on IWW, which increases the price per tonne of cargo transported. However, other factors also affect market prices, including seasonal demand, mode competition and direction of the trip. The projected water levels were combined with indicators on IWW freight activity and data on cargo capacity of different types of vessels to estimate the impact on the volume of cargo transported.

Finally, the results were combined with data for transportation costs and compared to a reference period to estimate the economic impacts of climate change on IWW. The majority of model runs predicted that the reduction in low water level days would benefit IWW. The monetary impacts were estimated to be between -EUR 89 million and EUR 174 million. However, there is local variation related to the discharge and riverbed morphology, which results in some locations being impacted differently. The average economic benefit estimated for each of the locations was projected to be EUR 31 million for Kaub, EUR 6 million for Wildunsmauer and EUR 4 million for Hofkirchen. Ruhrort was projected to have an economic loss of EUR 10 million.

To conclude, the results indicate that European IWW are one of the few sectors that will experience a negligible or even positive impact from climate change. Nonetheless, the location-specific nature of the water levels affecting IWW activity prevent any generalised impacts of climate change on IWW. Furthermore, IWW should be regarded as a system, so that if one part operates with disruptions, then other parts will be affected. This analysis only explores the impacts on four specific ports. Therefore, it does not account for any effects on the system as a whole.