European Commission

Science for Environment Policy

Ignoring flood risks leads to increasing losses: assessment should include climate change, land use and economic development

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Floods are devastating natural hazards, which can cause loss of life and substantial damage to buildings and other infrastructure. Assessing future flood risk is complicated by the influence of climate change, land-use change and economic development in an area. A study on an Alpine valley suggests that land-use change and urbanisation will affect future flood risk by 2030 more than climate change, but risks can be reduced by adopting low-cost adaptation strategies, such as building restrictions in flood-prone areas and residents taking their own precautions against flooding.

Climate change is expected to increase the severity and number of flood events in many parts of the world. Changing land use from natural vegetation or farmland to urban developments can also lead to an increased risk of flooding. Furthermore, economic growth can potentially put more buildings and other infrastructure, such as roads, at risk of being damaged in flood-prone areas.

Assessing the risk of future floods is important so that adaptation measures can be taken in time to reduce the impact, save lives and minimise the costs of flood damage in the most susceptible areas. However, assessing the contribution of climate change, land-use change and economic development to flood risks is not straightforward.

In this study, the researchers tackled this problem by applying a complex chain of models to assess the future risk of flooding in the upper part of the River Lech watershed in Tyrol, Austria. The study area is typical of an Alpine valley that is susceptible to flooding, having rocky terrain and steep valley sides. In the past few decades, there has been an increase in population in the area and a shift from agriculture to urban services, industry and leisure activities.

The researchers first assessed the flood hazard of the area. Using the series of linked models they estimated the local impact of moderate and more extreme climate change on the peak flow of the river and used this data to estimate the frequency of extreme flood events caused by climate change for the reference year (2006) and near future (2030).

Then they modelled the potential extent and depth of flood waters for different flood intensities (scenarios) in 2006 (the reference) and for the projected period under climate change in 2030.

To assess the impact of the flood, the researchers then identified potential land-use changes between 2006 and 2030 using four official, national spatial-planning scenarios previously developed for Austria. Focusing on structural damage caused by floods to residential buildings, they then assessed how much it would cost to replace or repair damaged buildings (existing and new developments) that would be at risk from exposure to the extent and depth of flood waters projected under climate change.

Finally, the researchers modelled the risk of flooding based on projected flooded areas and the loss of residential buildings expected in the extreme flood events for 2030 compared with 2006. They also estimated the individual contribution of climate change, land-use change and economic development on future losses from flood damage. The models used were validated on the basis of historic data, such as the flood in 2005.

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Compared with the contribution from land-use change and economic development, both moderate and more extreme climate change only had a small, or negative, impact on flood risk by 2030. Land-use changes and urbanisation contributed far more strongly to flood risk. For example, land-use change and economic development combined could increase the risk of a serious flood by 484% in 2030 compared with the risk in 2006 under more extreme scenarios (although under very conservative assumptions, only the impact of economic development stands out, with the effects of land-use change negligible).

Based on their assessment of flood risk, the researchers also investigated the effectiveness of flood adaptation strategies to reduce losses from flood damage, limited in this study to direct, structural damage to residential buildings. They developed a framework to compare the uptake of non-structural adaptation options that took into account the impacts of climate change, land use and economic development. The adaptation measures were those that could build resilience to flooding and could be implemented by the authorities (building restrictions in flood-prone areas) and individuals, such as protecting oil tanks from flooding to keep buildings from being contaminated by oil.

Flood risks could be reduced by 30% by adopting non-structural adaptation measures, even under climate change and land-use change scenarios. Ignoring the dangers of flooding could, however, increase losses (expected annual damage) by 17%, say the researchers. Such adaptation measures are low-cost compared with structural fortifications and the researchers suggest that flood adaption strategies and plans should incorporate building restrictions in flood-prone zones, improving risk communication and encouraging people to take personal precautions against flooding.

Despite a number of uncertainties associated with the modelling, the researchers say their study is useful as it highlights the importance of considering the combined influence of climate change, land use and economic development on flood risks in a specific area. They advocate the inclusion of all stakeholders in developing adaptation options. Furthermore, they suggest their study could be used as a pilot for regional analysis of flood risks.

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