The best way to combat increasing river flood risk in Europe? Water storage!

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Photo: Flood barrier in the low-lying part of the city of Hamburg, Germany. Flood proofing of urbanised areas is a good option at the local scale but not for large areas.

Costs and benexts of yood protection

There are several options for adapting our rivers to higher 𝟚ood peaks under global warming, and thus o𝟘set at least part of the 𝟚ood risk increase due to climate change. What options to choose depends on the costs of implementing these measures and the bene𝟙ts in terms of risk reduction. In addition to raising dykes, water storage areas can be created that can be 𝟚ooded in a controlled manner to store excess water temporarily and reduce peak 𝟚ows. Other options include 𝟚ood proo𝟙ng buildings and relocating people and their assets to other areas with negligible risk. The costs and bene𝟙ts of these four key 𝟚ood adaptation options across Europe have been assessed.

Current yood risk

In their study, the authors estimate that at present the average annual damage by river ℤooding in the EU and United Kingdom is ₹7.6 billion per year, while around 166,000 people are exposed to river ℤooding. Without climate mitigation, and global warming reaching 3 °C in 2100, and without further improvement of adaptation, average annual ℤood damage would rise to ₹44 billion per year by the end of the century, while annually nearly half-a-million Europeans would be exposed to river ℤooding. This increase is largely due to climate change. Further investments in adaptation will be needed to o◍set the projected rise in ℤood risk, the authors state.

Most ewective: water storage

Water storage areas that reduce river ℤood peaks are economically the most attractive option to adapt the river system to the changing climate, the authors conclude. Under 3 °C global warming by 2100, an annual investment of ₹2.6 billion per year until 2100 would reduce annual economic damage and population exposed in the EU and United Kingdom by more than 80% by 2100. This means that ℤood risk throughout this century would more or less stay at the current level.

Slightly less ewective: adaptation through river dykes

The optimal design of adaptation through river dykes in the EU and United Kingdom would require an annual investment of ₹3.1 billion until 2100 under the 3 °C global warming scenario. This would lower annual ℤood damages and the population exposed to ℤooding by about 70%. Additional investments in river dykes are therefore economically slightly less attractive than increasing ℤood storage capacity.

Flood prooxng and relocation not ewective on a large scale

Flood storage areas and river dykes are measures that reduce the hazard. Flood proo𝟙ng does not change the hazard but can reduce the impact of ℤooding. This assessment shows that ℤood proo𝟙ng is far less e◍ective in reducing ℤood risk than the hazard-reduction measures. The reduction in damage by ℤood proo𝟙ng of buildings in Europe is only 16%. The reduction of population exposed to ℤooding is zero, as ℤooding is not avoided. Flood proo𝟙ng of buildings is not an e◍ective strategy to protect large areas but can be an interesting additional measure for areas with a high concentration of exposed assets.

Of all four options, relocation is the least cost-e◍ective. This option is economically convenient in only a few locations in Europe. As a result, the risk reduction that can be reached by relocation is almost zero.

½Hybridl strategies

Naturally, we do not have to select only single type of measure. A combination of measures ⅚ ½hybridl strategies ⅚will likely be the best option to mitigate ℤooding at the lowest cost. Also, considering ℤood risk in land use planning will continue to be an e◍ective way to reduce

future flood impacts that cannot be replaced by adaptation strategies. After all, the projected increase of river flood risk is not just due to climate change but also due to the expansion of urbanisation in flood-prone areas.

Source: Dottori et al., 2023. Nature Climate Change 13: 196-202.