

# ECONOMIC ASSESSMENT OF NATURAL FLOOD DETENTION MEASURES

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Spatial measures for water detention like river redevelopment, decrease of sealing or extensification of land use are often ignored in the planning of flood protection measures. Main problem is the estimation of reliability and technical effectiveness of spatial measures and the quantification of the economic benefit, for example in cost comparison or cost-benefit analysis. Another aspect is the missing influence of local authorities to force the implementation on a large scale. The described economic assessment shows, that increased run-off due to intensive land use must be interpreted as an externality of land use. Upstream land users fully export their run-off to downstream riparian land users. Damages in downstream sections of the river system are therefore not only the results of natural hazards, but also partially of economic market inefficiencies. For a small scale river basin in Southern Germany the cause effect chain of land use and flood damage was assessed, and the economic dependencies evaluated. The conclusion shows, that water related objectives must be integrated into other sectoral policies to counteract market failures and foster sustainable flood protection.

## ARE FLOOD DAMAGES MARKET FAILURES?

On a river basin scale a lot of processes and developments are linked via hydrological processes and the river system. Land use like agriculture or settlements, river training, detention or technical flood protection are samples of human actions that influence the run-off regime. In the linked environment of a river basin upstream actions can influence downstream stakeholders. Effects of land sealing, draining, river development and diked forelands have been evaluated during the last years. General statements about the level of increase of floods can not be made. But it can be stated, that depending on the local situation in the catchment, all these effects cause an increase of flood peaks and the volume of a flood wave. In economic theory costs, that are not included in the production costs and are exported to third parties, for example pollution and its social costs, are called externalities. They exist because people can use a resource without a compensation for its use. This is especially a problem of public and common goods like air or water. As we see also the effects of land use on flood development can be called an externality of land use.

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## CASE STUDY

For a rural catchment in Southern Germany the dependencies of land use alternatives, flood development and flood damages were evaluated. A combination of hydrologic and hydrodynamic modelling was used to assess the effects of different land use scenarios on flood behaviour and extent of the flood plain in agricultural and settled areas. The comparison of the status quo with different alternative land use scenarios and river structures for reduced or without human impacts showed clearly the effect of land use and land use pressure in the flood plain on run-off. The estimation of the related potential damage for the scenarios or the costs for technical protection or detention measures to decrease damages up to the 100 year event gives an idea of the economic effect of this form of land use externality. From a technical but also from an economic point of view a relation between upstream land use and river training and downstream costs of floods can be stated.

## CONCLUSION

Reducing these damages depends in a first step on the legal situation. If the state grants land users the right to fully “export” their run-off, two solutions are possible: (1) affected communities bargain with land users about more sustainable land use techniques and maybe compensate resulting costs, (2) affected communities accept land use and try to protect against resulting increased floods. This solution would oppose the polluter pays principle. But, as we have seen, at the moment this solution is the standard. An alternative would be a legal obligation for run-off neutral or reducing land use practices. Of course the hydrologic and economic results of this study can in general not be transferred one-to-one to each river basin. Due to the individual hydrological situation each basin would react individually. Because of the extent of land use and its externalities and the actual legal situation the implementation of natural flood detention measures as an instrument of flood protection planning is not feasible. Its also difficult to assess the effectiveness, feasibility and robustness of these measures for an individual case and derive design values. As a result of the evaluation of other studies, dealing with the effects of land use and detention effects of the flood plain can be stated, that these natural measures have in general an impact on flood development, that should not be underestimated. The economic status of flood damages or flood protection costs being partially externalities of land use calls for political and legal intervention to foster the implementation of sustainable land use on a national scale. As a consequence existing agricultural subsidies could be extended by water related sustainability criteria. Land consolidation projects should always include the implementation of natural small scale detention structures, like grassed water ways, to reduce the concentration of surface run-off, or the renaturation of rivulets in the project area. In addition to flood related effects the suggested measures would provide additional benefit, because of an reduction of erosion, the retention of sediments and the redevelopment of natural river systems.

**Keywords:** flood detention, externalities of land use, river renaturation, economic assessment