Workshop 6 (synthesis): linking between flood risks and land use changes

Professor Klas Cederwall (Chairman)
KTH, 10044 Stockholm, Sweden

Maja Brandt (Rapporteur)
SMHI, 60179 Norrköping, Sweden

Abstract
Land use changes, such as deforestation, are increasing the world’s vulnerability to flooding. Detailed knowledge of the local situation is essential for risk assessment and design of effective flood prevention measures and governs the infrastructure and engineering measures implemented. However extreme floods in large catchments can overwhelm both natural capacity and constructed flood management measures.

Keywords Flood management; land use; planning; risk

Introduction
Flooding causes a huge economic burden and loss of life in the world, and the damages have also increased as a consequence of human activities that tend to make the built environment more vulnerable to natural disasters of this kind. Deforestation is often changing the environmental conditions to such an extent that it may trigger severe flooding, erosion and even landslides. Other examples of land use transformations that had significant negative effects on catchment run off were reported from Belarus where wetlands and peat bogs were converted into agricultural use.

A majority of catastrophic flood events have been caused by intensive rainfall, sometimes combined with snowmelt, tropical cyclones and typhoons. Some floods are caused by large surges in the coastal zone. At the workshop we concentrated on extreme floods caused by extreme meteorological events. Effects of failure of infrastructure, such as dam breaks, were not in the focus of the discussions in the workshop although it is evident that flood management is closely related to the existence and the performance of flood retention structures.

One important conclusion from the discussions is that the effects of land use changes, such as deforestation and urbanisation, on floods are well documented at small scale and for relatively frequent magnitudes of floods, but are difficult to detect for extreme floods in large catchments. At exceptionally extreme events the amount of water is so huge that floodplains and adjacent areas are literally drowned, the soils became fully saturated and all further rain leads to direct surface run off. It makes little difference then whether precipitation falls in the open landscape or on paved streets in an urban area. The significance of different land use patterns is then also reduced. Here we see an important effect of scale. The effects of land use change in small catchments and for moderate floods cannot be directly extrapolated to large catchments and for extreme flood situations as often advocated in the news media. The workshop group also discussed the effect of silting caused by land use changes in for example Bangladesh. Silting of floodplains and wetlands may be a problem that can make the effect of a flood even more devastating locally.

Flood situations are unique in their character. Analyses of different events from a flood
management perspective are important particularly if also combined with additional analyses providing insight into e.g. the fluvio-morphological characteristics of the rivers or other site specific features that may play an important role in the progress of such flood events. Effective flood forecasting, early warning systems, efficient communications network, flood mitigation routines and good understanding of how to deal with critical situations in society are important for saving life and reducing property losses. This emphasises the importance of a systems approach all through the planning and the performance of flood management in practice.

The decision maker wants to know how high the water can rise along the river and the problem this flooding may cause. Peak water levels are normally more interesting than peak discharges. We can never guarantee the highest level of flood, but we can estimate the risk related to different possible levels of flooding, which normally has a rather wide margin of uncertainty. Calculation of flows with very high return periods is associated with several difficulties and limitations. First, it can be questioned if the data sets available are representative for a longer period of time; secondly, the data set should be statistically homogeneous, which often is not the case; thirdly, we have to decide which appropriate statistical distribution or analysis method should be selected; and last, we have to consider the possible effect of climate change. Flood risk is a combination of vulnerability and probability. Man can affect the vulnerability but not really the probability. It is important to inform the decision makers and people living near the river or in the coastal zone of the risk of flooding they may be exposed to. Good physical planning based on risk assessments is important. There was an agreement that flood risk mapping is a good basis for such planning efforts.

Physical infrastructure should be adequately designed, constructed and maintained to withstand flood related impacts. Water related infrastructures may reduce locally flood effects but also flood retention and hence give rise to larger damages downstream. Engineering measures against flooding, such as dams and dikes, are common along many rivers in densely populated areas, but they are not the only means of mitigating floods. Structural measures may even create a false feeling of safety. Flood mitigation must therefore primarily be based on a good understanding of the water system and catchment characteristics.

The role of reservoir operation in river regulation and handling of extreme floods as a dynamic problem is complex. Small and medium sized floods are managed within normal operation, while very large floods often have to be discharged through the spillway which may increase the surprise effect downstream.

The group ended the workshop by emphasising the importance of such issues as capacity building, and exchange of data and information including the analysis of global and regional flood related data sets.