6.3. Riverbank erosion damage assessment

Figure 6.4: Riverbank erosion damage map of the study area
Chapter 7

Conclusions

The final stage of this research consists of a retrospective analysis of what has been done and which conclusions it is possible to draw from it. No recommendations related to the improvement of the method proposed are given here. They have been already included within the corresponding chapters.

After the development of this study, it is possible to conclude the following:

- The Turrialba Basin corresponds to a fluvial erosional system dominated by powerful rivers which can be considered within a juvenile to early-mature stage. For this reason, an intense riverbank erosion is taking place along the main rivers of the study area.

- Flooding in Turrialba City is strongly related to the occurrence of torrential rainfalls caused by the humid winds coming from the Caribbean Sea through the Reventazón River's valley. But flooding is also due to factors related to the location of population settlements and their rapid growth. This situation, combined with wrong policies in urban and landuse planning, has intensified the flood problems in the study area.

- Flash floods in Turrialba City are caused by the small rivers coming down from the mountains located to the west and southwest of the city. The large rivers of the study area (Turrialba, Aquiares and Azul) have not caused any flood, at least since 1891, but an intense riverbank erosion takes place along them.

- Due to meteorological reasons, December is the most hazardous month of the year in Turrialba City, because it is the month with the highest total monthly precipitation, with maximum peak discharges and also when the largest number of floods have occurred. In addition, February, in spite of being a dry month, also sticks out for the presence of important peak discharges and high monthly precipitations and because it follows December in the occurrence of flood events.

- The estimation of the return period of 50 years for the 1996 flood event, based only on precipitation data and not on discharges, implies that it has to be assumed that the rivers which caused this flooding will react in the same way to the influence of a specific precipitation. That means they will
generate flood events with the same return period of the precipitation that triggered them, in spite of the size differences between the basins.

- The distribution of the floodwater within Turrialba City is mainly determined by the existence, location and specific behaviour of bottlenecks and critical points during a specific discharge. That means, floods caused by these rivers tend to have always the same distribution, showing only variations in water depths and slight changes in flood extension, depending on the magnitude of the discharge. The location of the areas with high flood vulnerability and risk is also related to these critical spots.

- The areas considered with a high flood hazard correspond mostly to the middle part of the alluvial fan. Because of its slope and high permeability, this geomorphological unit should not be frequently affected by floods, but it is. It implies that the intense urban development on top of these deposits has intensified the flooding probability, by increasing the run off. On the other hand, flooding along the areas with a medium or low hazard (areas with less urban influence) occurs more naturally, due to the presence of flat areas with deficient drainage and low permeability.

- The 50-year return period flood scenario can be considered as having a high degree of reliability, because it is based on a detailed field survey. It is not applicable for the other two flood scenarios presented. These are only hypothetical cases derived from the first one, based mainly on field criteria. It influences also the reliability of the vulnerability and risk assessments, which were done using these scenarios.

- The proposed method for flood vulnerability assessment is based on the combination of an attribute map of the elements at risk and several flood scenarios for different return periods. This combination is carried out applying loss functions which reflect the real conditions of the area. Because it is a simple method, it can be easily applied in other parts of Costa Rica or elsewhere. It would only be necessary to adapt the loss functions to the new conditions. In the case of the method for riverbank erosion vulnerability assessment, no important modifications would be needed when applied in other study area.

- The loss functions developed in this research have to be considered only as a first approach, not as definitive tools. A lot of information is still needed in order to obtain a better product. A lack of time during the fieldwork impeded the collection of all the necessary data.

- Risk assessment plays a very important role in the planning and design of disaster mitigation measures. It is possible that in a certain area the total cost of the damages due to flooding is less than the cost of a structure that intends to avoid or reduce these damages, making its construction not-cost effective. A risk assessment previous to the construction of the structure will clearly show this situation and an alternative solution should be established.
• The success of a risk assessment depends mainly on a correct valuation of the elements at risk. It means that although the methods developed for the valuation of these elements, for the damage calculation and for the risk assessment are valid and applicable elsewhere, the costs are not real and then, the obtained damage and risk values are not completely reliable yet. Risk zonation maps, because of showing relative and not absolute damage values, are maybe not so far away from a definitive result derived from real costs.

• Damages due to riverbank erosion in Turrialba City tend to be much higher than damages caused by flooding. It implies that more attention should be given to this situation, in order to reduce such frequent and important losses.

• Structural and non-structural measures must be put into practice in the city of Turrialba, in order to reduce the economical losses due to flooding. First of all, the widening of the sectors along the rivers which act as bottlenecks is strictly necessary. Also, the urban development close to the critical areas, where rivers easily overflow due to natural conditions, should be avoided, unless structural measures are undertaken to control the problem. Finally, another key point is the development and application of rigorous policies related to landuse and urban expansion, which intend to control the increase of run off, erosion and water contamination and the decrease of soil fertility and capacity of discharge of the rivers.
Bibliography


