

The generation and use of cumulative probability distributions in flood risk assessment for the Mfolozi flood-plain

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Abstract

The traditional method of presenting flood damage is to calculate the mean annual flood damage. This approach does not explicitly point out the risk of floods and communities do not have an indication of what the risk implications of various floods are. A clearer picture of the uncertainty of flood damages as well as the damage implications can be created by constructing and using cumulative probability distribution curves. The inclusion of flood damage on a stochastic basis is most definitely an extension of previous flood research, which only used deterministic analysis. With this approach, flood-plain dwellers can comprehend better the nature, scope and potential effects of the risk involved. The main aim of this paper is to explain better the potential risk of floods to flood-plain dwellers by constructing and using cumulative probability distribution curves.

Introduction

Traditionally, potential flood damage was determined by calculating the mean annual flood damage (MAD). Important information, such as the average potential flood damage per annum, was obtained by means of this method. Notwithstanding the fact that this traditional method also provides limited risk information regarding individual potential floods, such as the probability of occurrence, it does not provide any risk information to flood-plain dwellers that will enable them to comprehend fully the financial implications of the risk involved.

To accommodate the above-mentioned limits, an adapted approach was developed to explain better the risk of floods to the community by constructing and using cumulative probability distribution (CPD) curves. A study of international literature revealed that there is very little, if any, information available on this adapted approach towards explaining the risk of potential flood damages. One reason may be the absence of agricultural economists in flood damage research. The international trend is to move away from engineer solutions and to move towards risk assessment, prevention and mitigation strategies. By using CPD the risk of flooding can be explained better. It is not the purpose of this paper to discuss the methodology of flood damage assessment, nor the detail of the flood damage simulation model (FLODSIM) exhaustively, mainly because these aspects have already been discussed. For more details regarding the last-mentioned, see Du Plessis (1998), du Plessis and Viljoen (1995; 1996 and 1997) and Berning et al. (2000).

The main aim of this paper is to explain better the potential risk of floods to flood-plain dwellers. The procedures and data collection will be discussed first. Thereafter, the total mean annual flood damage will be calculated by using an appropriate simulation model. Lastly, a cumulative probability distribution curve will be constructed and discussed.

Procedures

After developing an appropriate flood damage simulation model (FLODSIM) for the Orange River at Upington, it was decided to further develop FLODSIM for wider application in other flood-prone areas. The Mfolozi flood-plain (8 500 ha) was used as the study area and various types of data had to be collected for this area.

Collection of data

Types of data normally required for flood damage simulation purposes are topographical, hydrological and economic data. Such data must first be converted to the correct format for integration with FLODSIM. Before a typical flood damage simulation system can be discussed, it is first necessary to discuss the collection of the different types of data.

Topographical data

Land use, roads, tramways, levees, drainage systems and rivers in the Mfolozi area were digitised from 1:10 000 orthophotos. Unfortunately, the most recently available orthophotos were created using 1979 photography. The digitised data were updated with the aid of information derived from 1996 aerial photographs and Bosch & Associates in Durban made this digital information available. After this information had been obtained, it was possible to create a digital terrain model (DTM) for the Mfolozi flood-plain.

Two methods, namely a digital photogrammetry and an analogue stereoplotter, were mainly used to create a DTM. For this purpose the Helava Digital Photogrammetric Stereoplotter installed on a Sun Ultra computer was used to obtain a DTM for the Mfolozi flood-plain from controlled aerial photography at a scale of 1:30 000 (Schutte, 1997). A photogrammetric scanner was used to convert the analogue diapositives into a digital image format used by the Helava system, namely VITEC. Caution must be taken when ground control points are entered to ensure that the different images will connect at the same level. As sugar-cane in the Mfolozi flood-plain is cut at different times of the year and is thus not always of the same height, compensations had to be made for the height of sugar-cane in each cultivated field. The results from this method

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