

Extending flood damage assessment methodology to include sociological and environmental dimensions

MF Viljoen*, LA du Plessis, HJ Booysen

Department of Agricultural Economics, University of the Free State, Bloemfontein, South Africa

Abstract

Optimal and sustainable flood plain management, including flood control, can only be achieved when the impacts of flood control measures are considered for both the man-made and natural environments, and the sociological aspects are fully considered. Until now, methods/models developed to determine the influences of floods and flood control measures in South Africa, and elsewhere in the world, focus on the man-made environment and neglect the natural environment and social dimensions. Two models, recently completed in South Africa, namely FLODSIM (flood damage simulation model for irrigation areas) and TEWA (flood damage simulation model for urban areas) are cases in point.

This paper gives an overview of the development of flood damage assessment and mitigation methodology in South Africa. Emphasis is placed on the evolution from the traditional *ex-post* approach to the latest *ex-ante* approach in which the sociological and natural environmental dimensions are included. Deliverables from the presentation should be of value to researchers and managers in the fields of flood management and environmental impact assessment worldwide.

Introduction

Scientific research on flood damage in South Africa has had a fairly short history. Discussion of the developmental or growth path of the research is required to map out new directions. The initial research (the *ex-post* phase) with its narrow focus was necessary to set the stage for the subsequent *ex-ante* phase. Developments during the *ex-ante* phase range all the way from locality-specific models through generalised models to a holistic approach. The latter provides for the social and environmental impacts which are discussed later in the paper.

Ex-post research phase

Serious, concerted scientific research into flood damage determination in South Africa started in 1975 (after extensive flooding in 1974) when the Institute for Social and Economic Research of the University of the Free State and the Bureau for Economic Research of the University of Stellenbosch were commissioned by the Water Research Commission (WRC) to scientifically determine the nature and extent of the damage caused by the 1974 floods. The specific aims for this *ex-post* research phase were as follows (Viljoen, et al., 1977):

- To develop a methodology to identify and evaluate all forms of flood damage.
- To apply the methodology in specified river reaches so as to determine the damage for each reach.
- To describe the circumstances of each damage in such a way that a logical relationship between physical damage and flood circumstance could be established, thereby utilising the 1974 flood to construct a paradigm.
- To formulate the paradigm in such a way that the results would provide guidelines for application in other rivers.

The research involved with this project was conducted over the period 1975 to 1982. Of this research phase, the following characteristics, which are important for this paper, should be noted.

- The fundamental premise for determining damage was anthropocentric (flood effects were regarded as damage when the community suffered losses).
- The main emphasis was on determining direct tangible damage while the intangible damage was only described partially.
- The relationships between physical damage and flood circumstances were depicted by loss functions. The motivation for developing loss functions was that they are necessary building blocks in the traditional approach to determine an optimal set of flood control/mitigation measures for a flood area.

The data obtained during the *ex-post* phase were not sufficient to construct a complete set of loss functions needed for flood control planning. It was, in fact, possible to determine loss functions only for a few land-use types. It was a recommendation to supplement and/or follow the *ex-post* phase by *ex-ante* research. *Ex-ante* research would render it possible to construct loss functions without floods actually occurring. This would also allow for a complete set of loss functions to be developed.

Ex-ante research phase

After extensive flooding in 1988 and a request to revise the national flood disaster policy for South Africa, the WRC provided funds to the Department of Agricultural Economics at the University of the Free State to start the *ex-ante* research phase. This phase which can be subdivided into three sub-phases, started with the same basic premises of the *ex-post* phase as its point of departure (anthropocentric, focus on direct damage, loss functions needed for optimal flood control planning in cost-benefit framework).

The aims of the first phase (1991 to 1994) were specified as follows (Viljoen et al., 1996):

* To whom all correspondence should be addressed.

☎(051)401-2213; fax: (051)401-3473; e-mail: viljoemf@sci.uovs.ac.za

Received 3 October 2000; accepted in revised form 12 July 2001.