

# Methodology for the assessment of human health risks associated with the consumption of chemical contaminated freshwater fish in South Africa

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## Abstract

Studies have shown that the aquatic environment can be polluted by contaminants that are accumulated by freshwater fish and this may pose a health risk to the consumers of the contaminated fish. Developed countries like the United States of America have developed strategies and associated guidance documentation to conduct chemical contaminant surveys using fish and to use these data to reduce the health risk to the consumers of the fish. In this paper a generic methodology is presented that will give guidance in the undertaking of fish contaminant surveys to provide information regarding the possible health risk if the fish are consumed by recreational and subsistence fishermen in South Africa. The fundamentals of the methodology are based on catchment information, socio-demographic information of consumers of fish in the catchment, bioaccumulation potential and health risks of analytes, sound sampling design, risk assessment procedures and performing monitoring at different scales and depths. These aspects are presented as 10 major steps in the methodology of which the basic requirements are discussed to focus the surveys and optimise the application of resources. Although the methodology focuses on assessing the possible health risk to the consumers of fish many of the aspects would apply to any investigation aimed at assessing the chemical contaminant levels in fish. Furthermore as these surveys identify areas in the aquatic system where fish have unacceptably high chemical contaminant levels, this information can be used in catchment management programmes to put remedial actions in place that would ensure that the fish populations of the system are fit for present and future human consumption.

## Introduction

Pollution of the aquatic environment is one of the worst legacies of development of the 20th century. It is well documented that modern agriculture, industrialisation and urbanisation have negatively affected environmental quality and specifically aquatic systems (Förstner and Wittmann, 1983; Hellawell, 1986; Ellis, 1989; Mason, 1991; Dallas and Day, 1993; Johnson, 1996). In South Africa the pollution of freshwater aquatic systems can be linked to point-source discharges (waste water treatment works and industrial effluents) and diffuse surface runoff (agricultural, mining and urban). As a result of these anthropogenic activities, innocent people as well as other life forms may be exposed to harmful contaminants which may be released without adequate consideration of human health and the environmental effects (Tchounwou et al., 1996).

Effects on human health as a result of exposure to surface water contaminants can occur through contact recreation, drinking water and the consumption of contaminated food for example, fish and shellfish (US EPA, 1991). During contact recreation dermal absorption and incidental ingestion may pose a potential health risk. Drinking water poses a very high health risk; however, the risk can be reduced by effective treatment and by applying drinking water criteria. People consuming fish or shellfish are potentially at risk as these organisms have the potential to bioaccumulate harmful

contaminants from the aquatic environment (US EPA, 1991; Bevelhimer, 1995). The contaminants that have been bioaccumulated by the fish or shellfish pose carcinogenic, genotoxic and non-carcinogenic health risks to consumers (Reinert et al., 1991; US EPA, 1991). However, it must be stressed that the consumption of fish is generally beneficial as it provides a good source of protein, vitamins, omega fatty acids and basic minerals (Anderson et al., 1972; Zabik et al., 1995; US EPA, 1997). Additional benefits of consuming fish include a decrease in cardiovascular disease, a reduction in blood pressure in individuals, reduced colon and breast cancer risks, a decrease in pain from arthritis and a decrease in asthma attacks in asthmatics (US EPA, 1997). From the preceding it is evident that the consumption of fish is beneficial to humans, but if these fish are contaminated they pose a health risk to consumers.

As a result of the potential health risk associated with the consumption of chemically contaminated non-commercially caught fish, the United States of America has been issuing fish consumption advisories and bans (US EPA, 1995a,b; 1996; 1997; 1999). Fish consumption advisories are designed to reduce the risk to fish consumers by providing information that would lead to the voluntary restriction of fish consumption to levels that pose limited, if any risk. A fishing ban, on the other hand, involves the banning of the consumption of fish by closing water bodies for fishing and/or banning the possession of contaminated fish. Fish consumption advisories not only aim to minimise the health risk to the consumers of fish but also intend to minimise the negative effects of restricting consumption and fishing (US EPA, 1997).

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