Wetland-sediment toxicity from agricultural nonpoint sources (NPS) pollution

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Introduction: Recent agricultural developments programs in Tanzania have put pressure on expansion of farm lands to the fertile wetlands, where agriculture can continue during dry season to improve food security. The increased dependence on rich fertile soils of Kilombero Valley for agriculture has not been without its negative environmental effects. Thus, the sustainability of wetlands agriculture is being questioned, both economically and environmentally.

Study area: Kilombero Valley Ramsar Site is the second largest designated Ramsar wetland in Tanzania. It covers the surface of 7,967 km^2 with a catchments area of about 40,000 km^2. Despite of it being of high environmental importance, hosting a large variety of animals, both small and large scale crop production is practiced in this valley. Major cash crops include sugarcane and paddy rice. Other minor crops for food and supplemental income include:-sweet potatoes, maize, vegetables, peas, groundnuts and sesame. For the past decade the valley has been attracting a number of large scale teak plantations, sugarcane and paddy rice farming investors [1]

Materials and Methods: 67 samples of undisturbed sediment surface layers from seven rice and sugarcane plantations of the Kilombero wetlands were collected in spring 2012 - during rainy season and in January 2013 - during dry season. The samples were transferred to Germany and ecotoxicity of sediments and sediment elutriates to algae and bacteria was measured by standardized biotests (Algae growth inhibition test with *P.subcapitata*, sediment contact test with *A. globiformis*, luminescence bacteria test with *Vibrio fischerii*). The data sets from the first sampling were assigned to one of 3 levels of increasing toxicity, applying a fuzzy-logic based classification [2] in order to get a first overview over toxic responses in the area. Fuzzy rules using expert knowledge were used to formulate three quality classes as little/no potential risk, elevated potential risk and high risk [3] based on the ecological end point.

Results: The overall Algae growth inhibition tests for all stations showed the stimulated fluorescence rate ranging from min. 9% to max.92%. The growth rate was either stimulated or inhibited to an average of 10%. The LBT with elutriates showed the inhibition of metabolic energy from 7% to a maximum of 44%. The BCA (dehydrogenase activity) was inhibited to a maximum of 43%, and stimulation up to more than 90%. More than 70 percent of the sampling locations were classified as having no or low potential risk with regard to the ecotoxicological response. Few locations, however, showed induced elevated toxic responses, resulting in an assignment to the category of elevated potential risk. These locations were from Kilombero rice plantations, Mbingu Sisters-rice farms, and the TAC-Katrin rice farms where herbicides are frequently used. .

Discussion The samples that showed elevated toxic responses were mainly from the outlets streams that receive drains from the rice paddies, and the samples from the small forests located within the rice farms which are used as a pesticide mixing or sprayer filling point. During rainy season the toxic materials are flooded downstream to the river basin. Therefore a wider area of the ramsar valley is prone to contamination. The biotests are used as a cost effective and qualitative tool for the rapid screening of a large number of environmental samples to determine the presence of contaminants, which will be followed by various quantitative tests to ascertain a more precise and specific measurement.

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References:

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