Treating poor quality mine water using irrigation: Taking advantage of gypsum precipitation to remove high salt loads

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The imminentacid mine drainage problem facing the Vaal Basin, South Africa, potentially has major economic, social and environmental repercussions. Previous work done by the University of Pretoria has shown that common field crops can be economically grown using poor quality coal mine water when the water contains relatively high concentrations of calcium (Ca) and sulfate, as the ions precipitate out of solution as gypsum when concentrated in the soil profile. This results in root zone salinity being maintained at levels suitable for crop production and far below what would be expected when irrigating with saline water containing higher levels of more soluble salts such as sodium (Na), magnesium (Mg) and chloride (Cl). Furthermore, gypsum precipitation was found not to result in any physical or chemical changes that would adversely affect soil productivity over the long-term.Simulations of crop growth and salt dynamics using the SWB-Sci model were used to investigate the fate of salts when irrigating with likely neutralised mine water qualitiesprojected for Vaal Basin gold mines, a major challenge currently facing the most densely populated region of South Africa and economic hub of Africa. It was simulated that 34-69% of the salts could be precipitated as gypsum depending on water quality following neutralisation. Root zone salinity levels were simulated to remain below the threshold which would have an impact on wheat and soybean growth, while yields of maize were simulated to be impacted as this is a somewhat salt-sensitive crop. Irrigation therefore appears to be an attractive alternative to treating certain poor quality mine waters, making use of a more natural soil water filtration ecosystem service relative to costly and energy-intensive reverse osmosis which is the currentlypreferred option.

*This paper is based on findings from two Water Research Commission (WRC) projectsto be completed in 2014 (WRC project numbers*K5/2233//3 and K8/1058//3*). Financial and technical support from the WRC is hereby acknowledged.*