IMPACTS OF ARSENIC CONTAMINATION IN GROUNDWATER ON A VILLAGE PRODUCTION SYSTEM: CASE STUDY OF AFFECTED VILLAGES IN BANGLADESH

by

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ABSTRACT

The contamination of groundwater in Bangladesh by arsenic is a widespread and serious environmental problem, affecting mainly the rural population who rely extensively on groundwater for drinking and cooking. The study analyses the socio-economic impact caused by the arsenic contamination of groundwater on the production system of a village in Bangladesh so that proper mitigation measures can be identified. A sustainable development framework is conceptualized for the study where the three sub-systems of economy, society/community and environment interact in non-linear way to produce sustainable development of the major system of village. The research found that there is no single conclusive scientific explanation for the occurrence of arsenic in groundwater of Bangladesh. The study therefore looked at the problem as “man-made” and introduced the concept of entropy as an indicator of pollution.

The conceptual model of “joint production system” based upon the law of entropy provides a way to estimate energy/cost of removing pollution. The application of the concept of entropy to the arsenic contamination of groundwater is a unique feature of this study. The entropy value was calculated for a simple arsenic mitigation method by using the formula for mixing entropy. Arsenic compounds are mostly found in the mid-aquifers of Bangladesh. Groundwater containing rich arsenic diffuses into surface water according to the “principle of maximum entropy”. The estimation of entropy value indicated that the amount of energy resources needed to mitigate arsenic contamination for an estimated population of 30 million is low. However, the proper technology to remove arsenic successfully has not been found yet. The arsenic contamination process is an irreversible process. So a correct mitigation method will have to use diffusion in inverse direction, which is inherently difficult considering the volume of water and the length of time taken. This analysis implies that developing mitigation methods based on indigenous knowledge of the people is very important. Instead of treating contaminated water, use and management of other alternative forms of safe water, such as rain water, surface water and deep aquifer water is more sustainable. The analysis revealed that, Bangladesh should opt for a new and low cost technology to provide safe drinking water, and that the

waste (arsenic sludge) created as a byproduct in all arsenic-removal techniques should be taken into consideration.

The study conducted survey work in a few affected villages of the Northwest region in Bangladesh. The household survey gathered information on the respondents (the majority of whom are affected by arsenic), water usage and sources, knowledge of the arsenic problem, changes in the source of water for drinking and cooking, testing of tubewells, arsenic mitigation technologies and socio-economic information on the households. The analysis explored the level of knowledge among the rural people on the problem. The study found that the level of knowledge was insufficient, although compared to a decade earlier, it has increased considerably. People know more about the health problems caused by arsenicosis but lack knowledge about mitigation aspects. Among the arsenic mitigation technologies, households in the study area preferred technologies that use alternate safe water sources such as dug-well, rainwater harvesting, pond sand filter, and deep tubewells, to technologies that remove arsenic by various chemical treatments**.** A conceptual model for 'socially adaptable arsenic mitigation technology' is proposed.

The problem of arsenicosis has created economic impacts in terms of loss of labour hours, reduced yield in crop production, increased yearly expenditure, and social impacts in terms of psychological stress, discrimination toward female victims, and family problems which cumulatively affect the cohesive fabric of the village system.

The study revealed that the role of NGOs is crucial to the mitigation of the problem, although there remains a lot to be done. The NGOs have been found contributing to the knowledge-base creation process in the village community as the villagers are showing marked behavioral changes in water-use practice. Using participatory appraisal methods and a "learning by doing" approach in their work with the community, the NGOs are found able to create knowledge and manage it at the village level of the political hierarchy in Bangladesh. The household respondents however expected the NGO do more to help them to overcome the arsenic problem in the village.

A conceptual framework based on the Integrated Assessment for sustainable development for overall arsenic mitigation is suggested. Present policies and programmes of the Government of Bangladesh are not taking into proper consideration the knowledge and perception of the rural communities. This framework can be used by policy makers to understand and evaluate current policy on arsenic mitigation. The study outlines broad policy measures, such as creation of “village map” and the use of “entropy” as a pollution indicator.