Application of Fluoride Ion-Selective Electrode (FISE) and GIS in managing human health risk of high-F- groundwater to a rural population in central Vietnam

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Fluorosis is a widespread human health problem arising predominantly from excess fluoride intake in drinking water. It particularly affects rural populations in areas with high-F^- groundwater, an example of which is Khanh Hoa province, where the first incidence of fluorosis in Vietnam was reported in 1987 and where the health issue has grown as increasingly polluted rivers have been replaced by shallow wells and boreholes as the major domestic water supply.

The provision of large earthenware jars to store rainwater and simple ion-exchange apparatus have proved of limited success in mitigating the problem. That fluoride is both colourless and tasteless when in excess concentration (> 1.5 mg/L) presents an unfortunate dilemma for a local population educated in the adverse health implications.

Study of the efficacy of an interactive GIS-based system indicating the F^- status of domestic water sources was initiated in 2004 in Ninh Hoa district, ~1,200 km^2 in area with population of 214,000 of which up to one-third has been shown to be at risk from fluorosis. The fluoride ion-selective electrode (FISE) provides a relatively inexpensive analytical technique for determination of F^- in water that can be applied in the rural situation. Results from 1138 groundwater samples gave average 2.13 mg/L with a maximum of 28.1 mg/L F-, with 42.5% of samples analysed exceeding the Vietnam drinking water standard of 1 mg/L. Twelve of 27 communes in Ninh Hoa and the adjacent Khanh Vinh district were shown to have wells presenting a risk of fluorosis.

We have found FISE to be a practical, reliable and cost-effective means of fluoride analysis in the field. A working system can be set up locally to produce reliable data in the range 0.1 – 30 mg/L range required for evaluation of health impacts, that compare satisfactorily with results of laboratory-based high-performance ion chromatography (HPIC).

Dissolved F- concentrations in domestic water sources in the study area have been entered into an interactive GIS enabling community officials and local population to identify sources of safe potable water and those posing a significant health risk, that frequently occur in close proximity. Construction of a

fluorosis risk map has also been possible.

The effective use of field-based FISE analysis and its application in generation of a GIS for management of the health risk of fluorosis in the local population of Ninh Hoa will be discussed. The long-term viability of such a system is reliant upon the F- distribution in the groundwater remaining stable. Preliminary results from a recently commenced study revisiting wells analysed 8 years previously, and expanding the GIS to other areas of fluorosis risk in central Vietnam, will also be presented indicating whether the current or a more dynamic model of groundwater fluoride distribution is required.

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