# STREAM SEDIMENT, SOIL AND FORAGE CHEMISTRY AS INDICATORS OF CATTLE MINERAL STATUS IN NORTH-EAST ZIMBABWE

**F M Fordyce[1], J D Appleton[1], D Masara[2], N Ndiweni[3], and J Topps[4]**

1 British Geological Survey, Keyworth, Nottingham NG12 5GG
2 Veterinary Research Laboratory, P O Box 8101, Causeway, Harare, Zimbabwe
3 Department of Preclinical Veterinary Medicine, University of Zimbabwe, P O Box MP 167, Mount Pleasant, Harare, Zimbabwe
4 Department of Animal Science, University of Zimbabwe, P O Box MP 167, Mount Pleasant, Harare, Zimbabwe

Soil, forage and animal tissue analyses have been used by previous workers in tropical regions to identify trace element (mineral) deficiencies and toxicities in grazing livestock (McDowell et al.,1984). However, in many cases results tend to be equivocal and have to be interpreted with caution. Regional stream sediment surveys are a cost effective method of mapping the background variations in trace elements in the environment. In order to assess the relationship between environmental trace element levels indicated by stream sediment geochemical maps and cattle blood trace element status, a detailed study was carried out in north-east Zimbabwe. The study area comprises thinly populated communal lands of the Mudzi, Mutoko and Rushinga Districts which are farmed on a subsistence basis. No cattle mineral supplementation is currently practised in the area.

Zinc was the principal trace element investigated because (1) cattle blood samples are easier to collect than the liver samples or bone samples required for the reliable evaluation of Ca, Co, Cu, P and Se status; (2) blood serum Zn is the most widely accepted indicator of cattle Zn status; and (3) a wide variation in geochemical levels of Zn had been identified by a regional stream sediment geochemical survey. It is suspected that the lack of correlation between soil, forage and animal blood compositions reported in previous studies may result, in part, from the restricted variation in environmental trace element levels in the areas investigated. An area with a wide range of Zn was therefore selected for study and was subdivided into three regions of low (<35ppm), medium (35-70ppm) and high (>70ppm) Zn on the basis of existing stream sediment data. Soil, grass, leaf and cattle blood samples were collected from five districts within each of the regions, in order to determine if the distinct variation in stream sediment Zn levels was reflected in soils and forage as well as in the cattle blood. Within each of the 15 districts, blood samples were collected from 20 cattle and soil, grass and leaf samples were taken from up to 5 areas grazed by the cattle during the weeks preceding blood sampling. During the wet season, cattle in the study area graze and browse on a wide variety of indigenous grasses, shrubs and trees, so a representative selection of grazed and browsed species were included in the grass and leaf samples in an attempt to obtain an indication of the overall trace element levels in forage consumed by the cattle. Sampling was carried out in May, at the end of the wet season. Soil and forage samples were analysed for Ca, Co, Cu, Fe, Mg, Mn, P and Zn by ICP-OES following digestion in hot HCl. Ca, Cu, Mg, P and Zn were determined in cattle blood serum by AAS.

Certain elements such as Ca, Fe, Mg, Mn, and P in soil reflect major differences in bedrock composition, being lowest over granite and grey gneiss terrains; moderate over migmatitic gneiss and high over gneissic metasedimentary rocks. Similar trends are seen in Co, Cu, and Zn in soils and Co, Cu, Mn and Zn in stream sediments. Although bedrock composition clearly exerts the greatest influence on regional variations in trace elements, adsorption of Co, Cu, P, and Zn by secondary Fe and Mn oxides is also important in the fersiallitic soils.

Positive correlations between district mean stream sediment, soil, grass, leaf and cattle blood Zn values are all significant at the 95% level. This confirms that cattle Zn status reflects forage Zn intake which in turn reflects Zn levels in soils, stream sediments and ultimately in rocks. Although there is no overlap in district mean stream sedimen t Zn values between the low, medium and high Zn regions, there is some overlap in the corresponding ranges of district mean values for soils, grass, leaves and cattle blood. 80% of soil and leaf district means frrom the low zinc region are lower than means for these media for the medium and high Zn districts. For grass and cattle blood there is more overlap: only 60% and 40% respectively, of the mean values for the low Zn region are less than values recorded for the medium and high zinc districts. There is considerable overlap between the ranges of soil, grass, leaf and blood district mean values for the medium and high Zn regions. The mean Zn values in soil, grass and leaves are no more effective than Zn in stream sediments for identifying districts with low cattle blood Zn levels.

The mineral status of a herd or district is often recorded in terms of the percentage of animals with blood concentrations below a critical level and the same procedure is often applied to forage and soil data. In northeast Zimbabwe, Zn is below the critical level of 30ppm in 100, 100 and 85% of leaf samples and 100, 85 and 70% of grass samples from the low, medium and high Zn regions respectively whereas only 18, 9 and 2% of cattle have blood Zn concentrations below the critical level of 0.8ppm. This discrepancy has been noted in other areas (Peducassé et al., 1983).

Although significant correlations occur between district mean Cu in sediments and soil (r = 0.77) and between Cu in leaves and grass (0.54), there are no significant correlations between Cu in cattle blood and Cu in other sample media. This may reflect the restricted range of Cu in soils and sediments (4-30 ppm) which is much less than for Zn (10-110ppm) or it may confirm that Cu in blood is not the most reliable indicator of Cu status.

Whereas undernutrition is probably the main cause of low reproduction rates amongst cattle in the communal lands of Zimbabwe, mineral deficiencies undoubtably also have a negative effect. Once the more limiting energy and protein deficiencies have been rectified, any method of identifying those areas particularly susceptible to mineral deficiencies may be of considerable value as it will permit the design and implementation of effective supplementation programmes which will lead to even higher levels of productivity. This study has demonstrated that regional stream sediment geochemical mapping can be used to identify those areas where cattle may be particularly susceptible to zinc deficiencies. Districts with the lowest cattle blood Zn status can be identified as effectively using stream sediment data as they can with soil or forage analyses.

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