



SOKOINE UNIVERSITY OF AGRICULTURE FACULTY OF AGRICULTURE

Research Brochure on

**Risk of Uranium Contamination in Selected Agricultural
Soils of Bahi District in Central Tanzania and its Transfer in Food Chains**

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Introduction

Commercial superficial uranium (U) deposits have recently been confirmed in Bahi and Manyoni districts in Central Tanzania. The deposits occur in seasonal wetlands with closed drainage system, which are surrounded with several hills of granites (Plate 1). The wetlands are fully utilized for human settlement and growing of rice, finger millet, sorghum, vegetable and other crops. In addition, the wetlands are used for grazing domestic animals, salt harvesting, and fishing for many years without knowledge of the presence of superficial U deposits. Equally of concern is that surface and ground waters, which some contain substantial amounts of dissolved U salts, are used for drinking and irrigation. Drinking contaminated surface and groundwater is among the potential pathways by which people and animals are exposed to U compounds (Bensoussan *et al.*, 2009).



Plate 1: Project Team in Bahi wetland, granite hill in the far forefront

In soil, U does not often create a radiological hazard to humans, but can cause biochemical toxicity. This is possible because U is taken up and accumulated by plant tissues (Anke *et al.*, 2009). And through the food chain, it can be transferred from the ground to humans and other living species. The dangers arising from the biochemical toxicity of U are considered to be about six times higher than those from its radioactivity (Schnug *et al.*, 2005). Since the majority of the local communities in Bahi District depend on agriculture for their livelihood, spatial distribution of U in agricultural soils, its mobility, and availability for plant uptake were some of the aspects this study aimed to understand. In addition, the project wanted to know the levels of U in water

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The U levels in soil increased with depth and clay content. Along the slope, relatively higher values were found at the bottom of the slope as compared to the upper elevation. The highest U values of 222-743 $\mu\text{g kg}^{-1}$ were found in Bahi wetland, followed by 125-238 $\mu\text{g kg}^{-1}$ obtained north of Ilindi Playa Lake. At Mpamantwa, U values found in soils ranged between 24 and 114 $\mu\text{g kg}^{-1}$. All values, which were obtained from 0-30 cm depth, were within the tolerable limit for crop production. Plants can survive in U contaminated soils of 3000 μgkg^{-1} (Gulati *et al.*; 1980). The low amount of uranium in upper horizon could be influenced by leaching especially when uranium form soluble compounds with other materials like carbonates and phosphates (Navas *et al.*, 2002).

Tap water at Ilindi Primary School, which is used by school pupils, teachers and residents had 95 μgL^{-1} of U. ¹ Whereas, Ilindi Playa lake water, which is used by animals for drinking had the highest mean value of 1233 $\mu\text{gU L}^{-1}$. In Bahi Ward, high U level of 67.6 $\mu\text{g L}^{-1}$ was found in one of the tributaries of Bubu River. Recommended level of U in drinking is less 30 $\mu\text{gU L}^{-1}$ (WHO, 2012; USEPA, 2011). Thus, continuing using water with high U levels is endangering the community and livestock.

Soda ash produced at Ilindi had 1910 $\mu\text{g/kg}$, the level that makes this product unsafe for human and animal consumption and, thus, should preferably be avoided. The high value in soda ash could be due to the affinity of uranium to carbonate. The carbonate form soluble complexes with uranium (Navas *et al.*, 2002). Among the studied food crops, grains of finger millet from Mpamantwa had the highest U level of 10.4-32 $\mu\text{g kg}^{-1}$. Other crops had less than 10 $\mu\text{g kg}^{-1}$. Out of 171 cereal and cereal products analysed in Germany, the maximum U values obtained ranged between 3-9 $\mu\text{g kg}^{-1}$ (Efsa, 2009). This implies that U values found in finger millet could be above normal and thus, precaution needs to be considered to those who use finger millet flour on daily basis. High U value in food product is assumed to intensify the risk of cancer to the end-users.

Conclusions

Research findings showed that water and soda ash in Bahi district are contaminated with U and thus, should be used with caution. Finger millet grains especially from Mpamantwa Ward had relatively higher level of U as compared to other cereal grains from elsewhere. It is recommended that public should be informed through government machinery. However, further detailed studies should be launched to identify areas and foodstuffs in Bahi District with high U levels for the safety of the people.

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and other food groups produced in the district. People in Bahi District are required to know this information because U and its compounds are carcinogenic and highly toxic (Sasmaz and Yaman, 2008). Thus, the project paved way on the human safety and proper utilization of available produces and natural resources in Bahi District.

Description of the study area

The study was conducted in Bahi, Mpamantwa and Ilindi Wards in Bahi District, central Tanzania (Fig.1). The District lies between Latitude 4°and 8° South and Longitude 34°and 38° East. It a semi-arid district with unimodal and erratic rainfall of about 500 to 700 mm that falls between late November and mid-April (Swai *et al.*, 2012). The district has an estimated population of 221,645 people, mostly farmers who keep livestock of different types (National Bureau of Statistics, 2012). Other economic activities include fishing in swamps and rivers (particularly during the rainy season) and production of salt and soda ash for domestic consumption and export elsewhere.

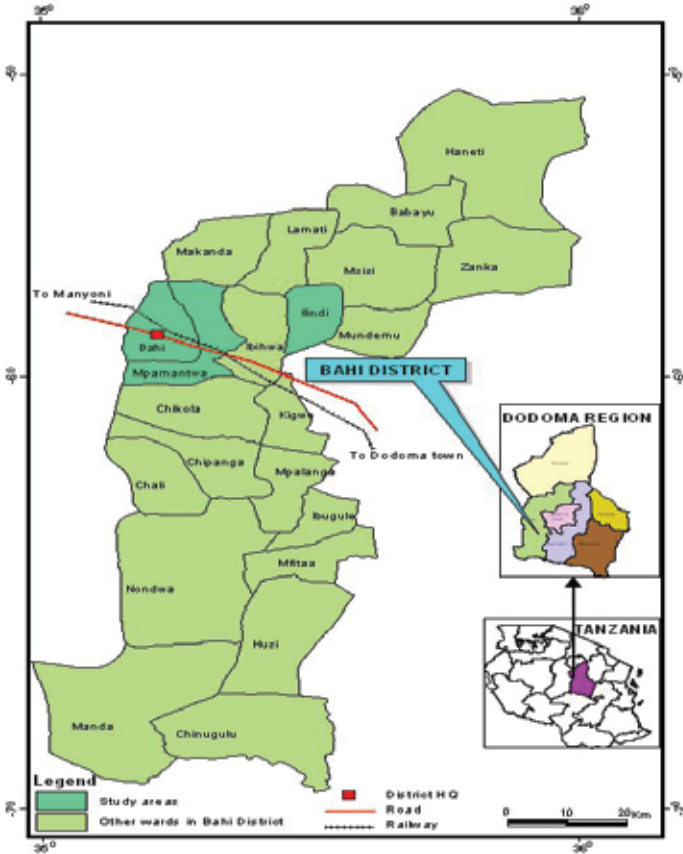


Fig. 1: Study area

Data Collection

Field data were randomly collected from three wards, namely, Ilindi, Mpamantwa and Bahi in Bahi District. Collections of data were carried out by two MSc. students from SUA in collaboration with Ward Extension Officers under the guidance of three SUA Supervisors. Data collected included 79 soil samples, of which 14 were from maize farms, 14 from finger millet farms and 15 were from rice farms. The remaining 36 soil samples were collected in soil profiles (Plate 2) and transects cross each ward.



Plate 2: Description of one of the soil profiles in Ilindi Ward

In the same farms, triplicate samples of grains and shoots of maize, rice and finger millet were collected. Furthermore, triplicate samples of cassava leaves were picked from 3 farms in Ilindi Ward and another 3 farms in Mpamantwa ward. In addition, triplicate surface and underground water samples were randomly collected from 9 sites, three from each ward, giving a total of 27 water samples (Plate 3).



Plate 3: Collecting water sample in one of the villages in Mpamantwa Ward

Also, 12 locally produced salt (Plate 4), 3 soda ash and 9 catfish samples were collected from Ilindi Ward for laboratory analysis.



Plate 4: Traditional salt production in Ilindi Ward

Research findings

Analysis for uranium levels in the collected samples was carried out in Dar es Salaam (DSM) at the Chief Government Chemist Laboratories Agency using Inductively Coupled Plasma – Optical Emission Spectroscopy (ICP- OES). The results found are summarized in Table 1

Table 1: Uranium levels in soil and food groups from Bahi District

S/N	Sample	Range
1	Soil	<10 to 743 $\mu\text{g kg}^{-1}$
2	Cassava leaves, maize and rice grains & shoots	<10 $\mu\text{g kg}^{-1}$
3	Finger millet grains	10.4-32.0 $\mu\text{g kg}^{-1}$
4	Salts	<10 $\mu\text{g kg}^{-1}$
5	Soda ash	1910 $\mu\text{g kg}^{-1}$
6	Catfish	<10 - 17.78 $\mu\text{g kg}^{-1}$
7	Water	<10 - 1233 μgL^{-1} (Ilindi Ward)
		<10 - 16.7 μgL^{-1} (Mpamantwa Ward)
		<10 - 67.6 μgL^{-1} (Bahi Ward)