RISK ASSESSMENT DUE TO CONSUMPTION OF NATURAL RADIONUCLIDES IN CASSAVA FROM KILIMAMBOGO, KENYA

The Ninth International Symposium on Naturally Occurring Radioactive Material

23-27 September 2019
Denver, Colorado

NYAMBURA CATHERINE

Abstract-190

SUPERVISORS
Dr. Nadir Hashim and Dr. Margaret Chege Kenyatta University, Kenya

Prof. Shinji Tokonami Hirosaki University, Japan

INTRODUCTION

- Man need food to survive
- Food can be contaminated with different forms of pollutants including radionuclides
- Radionuclides are present in the environment; rocks, soils, underground water, plants and the atmosphere
- Use of fertilizers leads to elevation of uranium series nuclides in food crops

INTRODUCTION

- Naturally Occurring Radionuclide Materials contain any of the primordial radionuclides as they occur in nature, eg. Radium, Uranium, thorium, potassium, and their radioactive decay products, such as radium and radon, that are undisturbed as a result of human activities.
- The common radionuclides found in food are;

Potassium-40, Thorium 232, Radium-226 and their associated progeny.

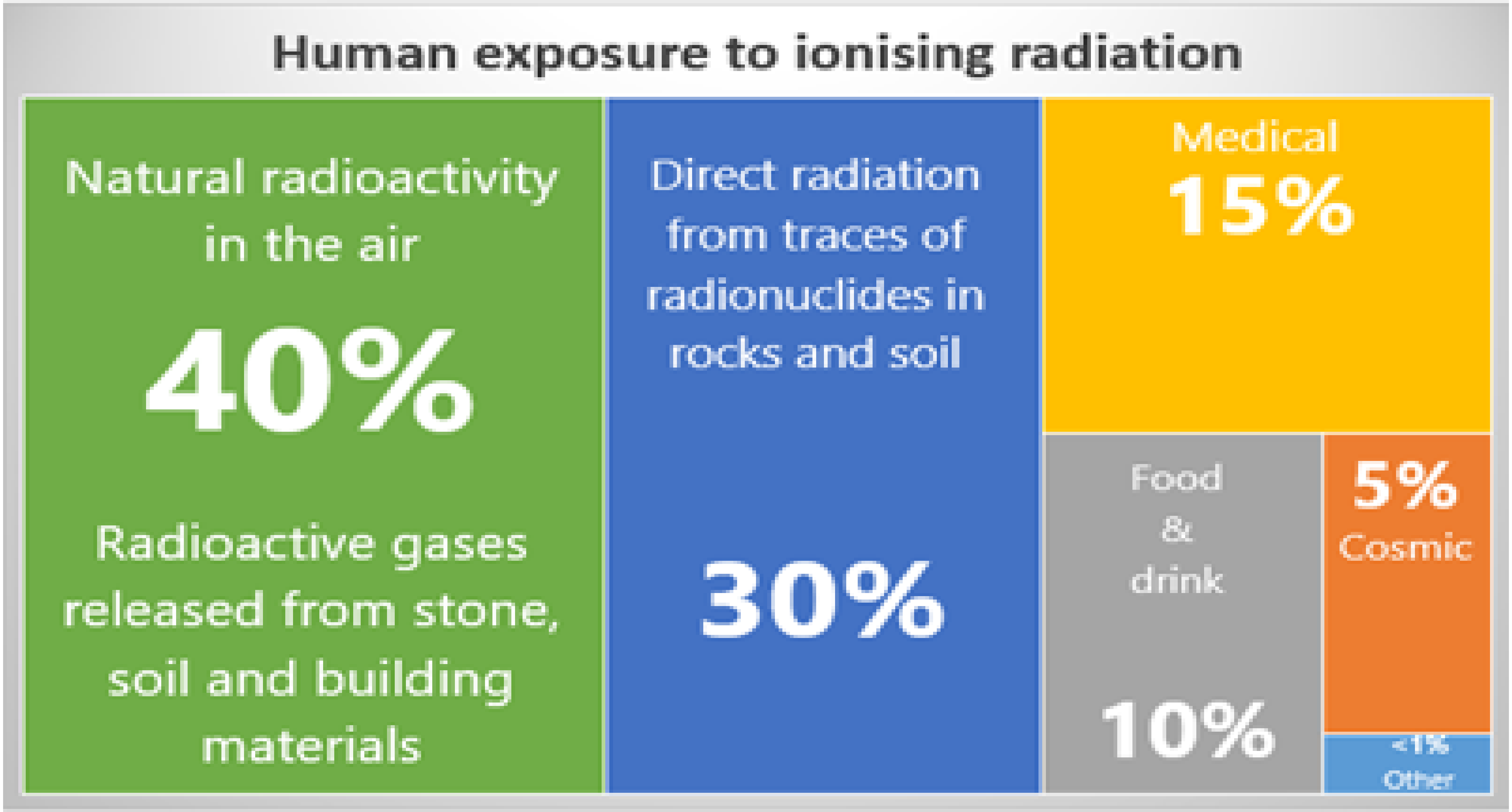
INTRODUCTION

- The radionuclides may get to the food chain through;

I. Uptake: roots of plants take in radionuclides from the soil.

II. Deposition: radioactive particles in the air settle onto crops.

III. Bioaccumulation: radionuclides accumulate in animals that ingest plants, feed, or water containing radioactive material.


Human exposure to ionising radiation
Natural radioactivity in the air
40%
Radioactive gases released from stone, soil and building materials
Direct radiation from traces of radionuclides in rocks and soil
30%
Medical
15%
Food & drink
10%
5%
Cosmic
<1%
Other

INTRODUCTION

- People are therefore at risk if they ingest contaminated food
- As a result our bodies contain small amounts of radioactive materials

Ionizing radiation from decay of these radionuclides can affect the living cells and thereby damage their genetic materials (DNA).

The cells may;

i. Be repaired
ii. Die
iii. Damaged

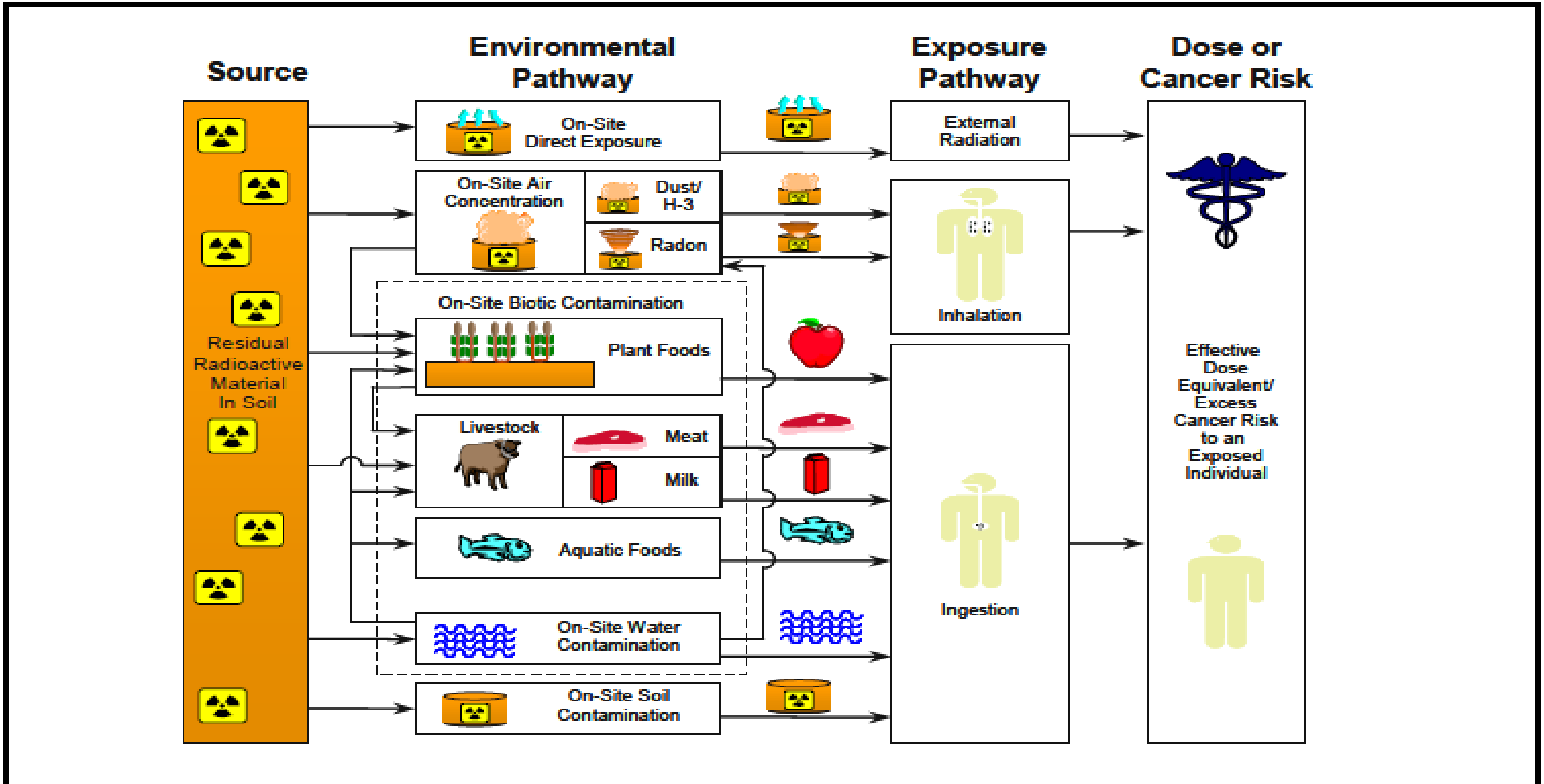
The damaged cells may multiply abnormally thereby becoming cancerous depending on the dose received

Therefore;

- Studies on the radioactivity of the consumable parts of food crops help to estimate the ingestion dose to the general public.

This was analyzed to estimate radionuclide intakes and doses received by the population via ingestion

Radiation exposure pathways



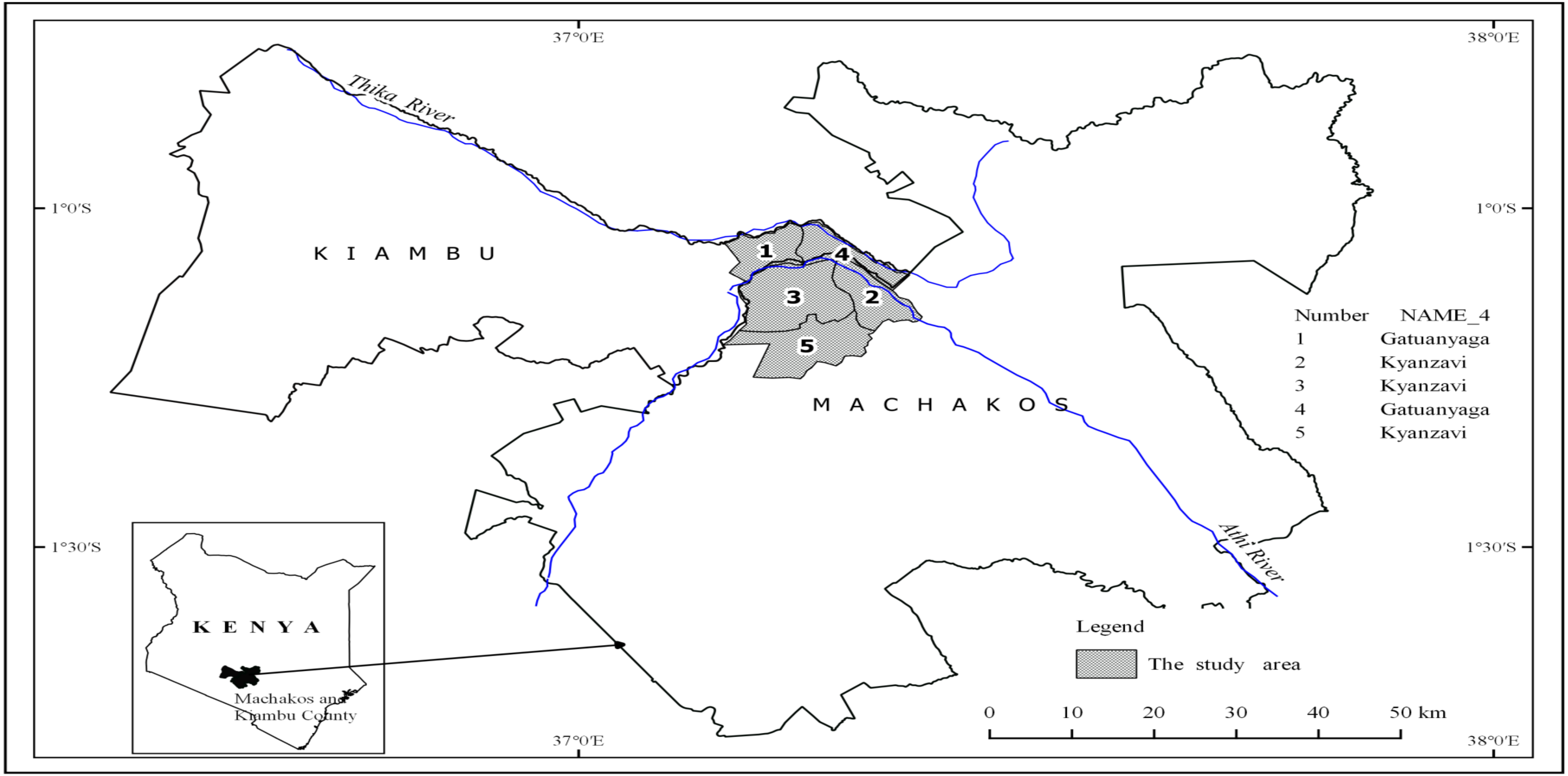
Objectives

i. Determine the activity concentration of ^{226}Ra, ^{232}Th and ^{40}K in cassava tubers and cassava leaves in Kilimambogo region.

ii. Determine the internal exposure due to consumption of cassava tubers and leaves by the residents

iii. Determine the transfer factors of primordial radionuclides in tubers and leaves

Study area-Kilimambogo, Kenya



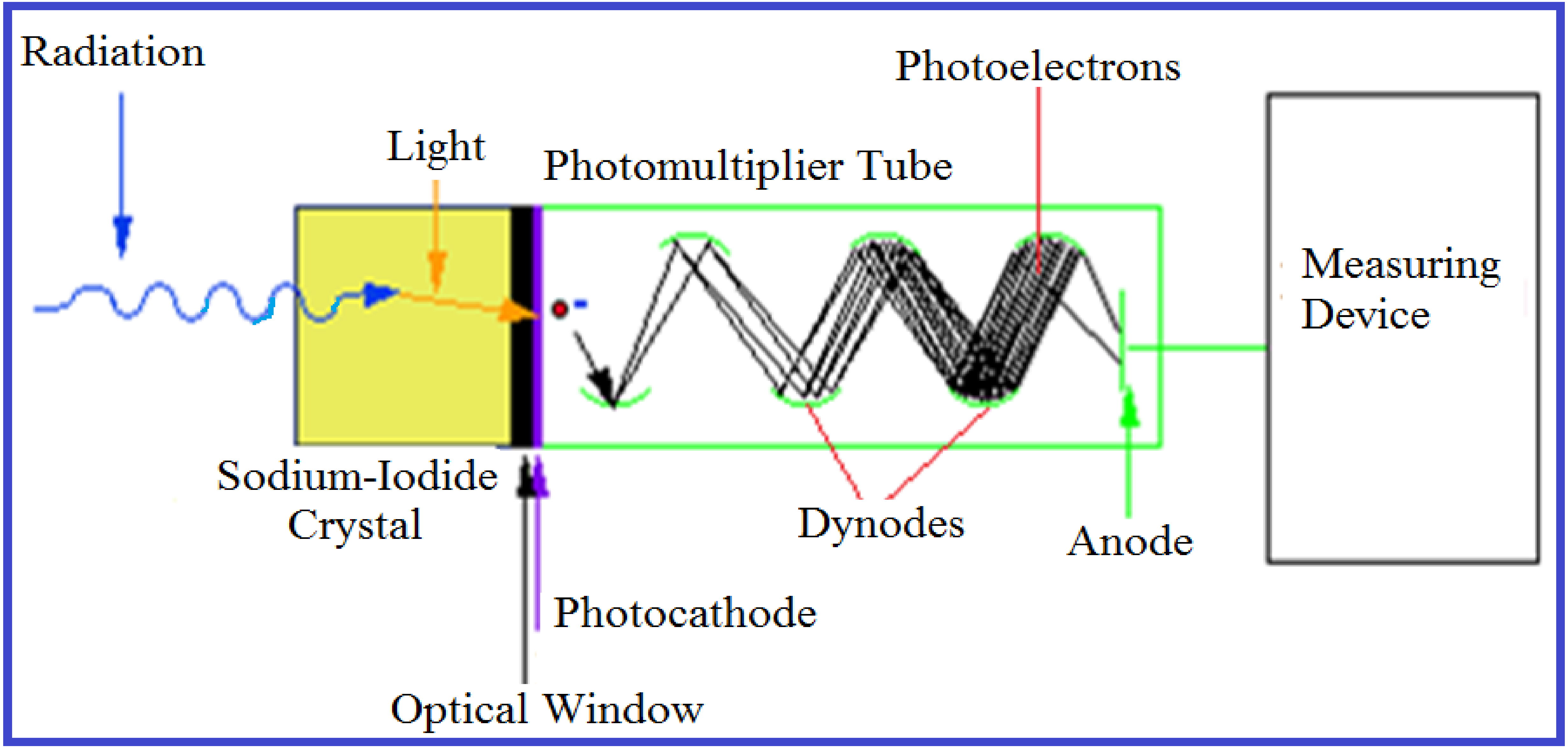
A cassava plantation in the study region

METHODOLOGY

Cassava tubers and leaves

- Outer skin of tubers removed Washed clean, Cut into small pieces.
- Cassava leaves washed clean and cut into small pieces.
- Samples were sun dried, then oven dried at 110^{0}C for 24 hrs.
- Samples ground to pass through a mesh-sieve of 2 mm.
- Samples were sealed in air tight containers and stored for 30 days to attain secular equilibrium.
- NAI (TI) detector used to determine activity concentration of ^{226}Ra, ^{232}Th and ^{40}K in the samples.

Schematic diagrams of NAI (TI) detector



Activity concentration

$$A_S = \frac{N}{\varepsilon P_\gamma M_S T} \qquad (1)$$

A_s = activity concentration of the sample in Bq kg^{-1};

N=net counts under the photopeak for each sample in a given energy of interest;

T is the counting time;

ε is detector efficiency at the given energy of interest;

P_γ is the absolute probability;

M_s, mass of sample in kg

Internal exposure from cassava consumption

$$D = q \sum C_i F_i \quad (2)$$

C_i = Concentration of radionuclides

q = Ingestion rates (Tubers=90 Kg/y, Leaves= 25Kg/y)

F_i = Corresponding dose coefficients for the public

2.8×10^{-4} mSv Bq^{-1} for ^{226}Ra

2.3×10^{-4} mSv Bq^{-1} for ^{232}Th

0.062×10^{-4} mSv Bq^{-1} for ^{40}K

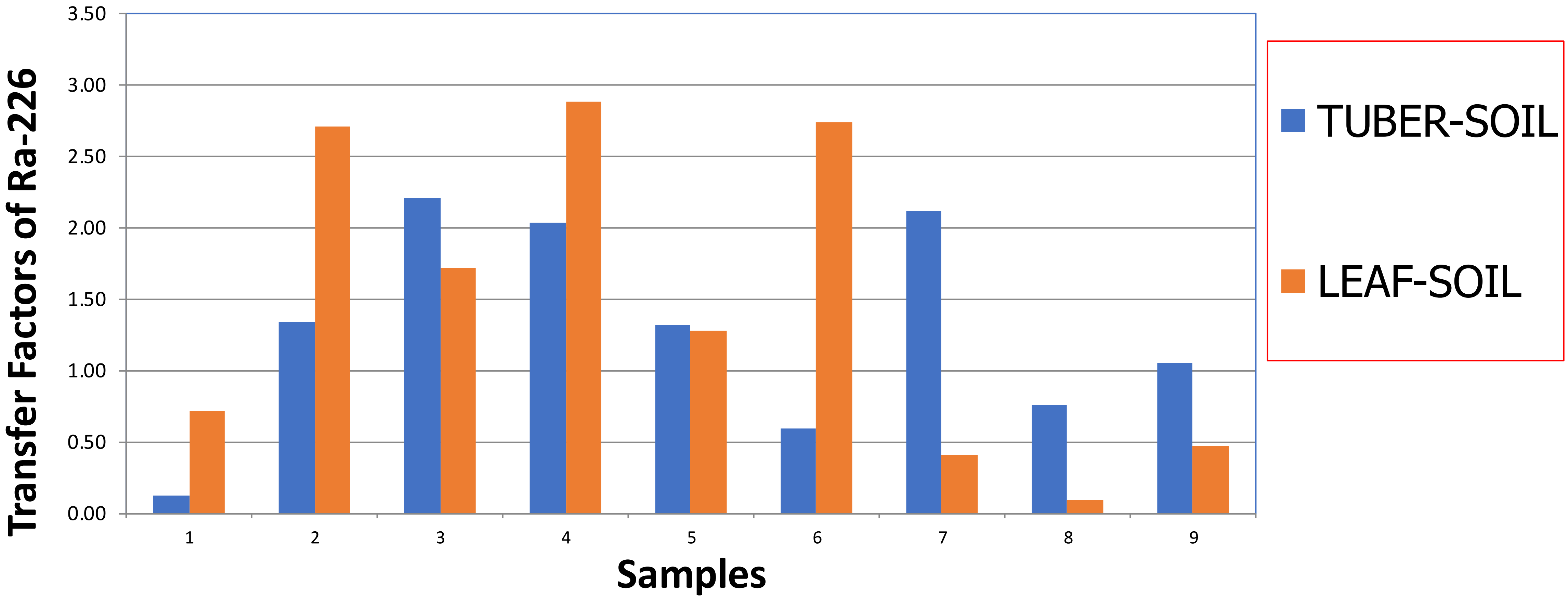
Transfer factors

- $Transfer\ factor = \frac{Activity\ concentration\ in\ plant\ (dry\ weight)}{Activity\ concentration\ in\ soil\ (dry\ weight)}$ (3)

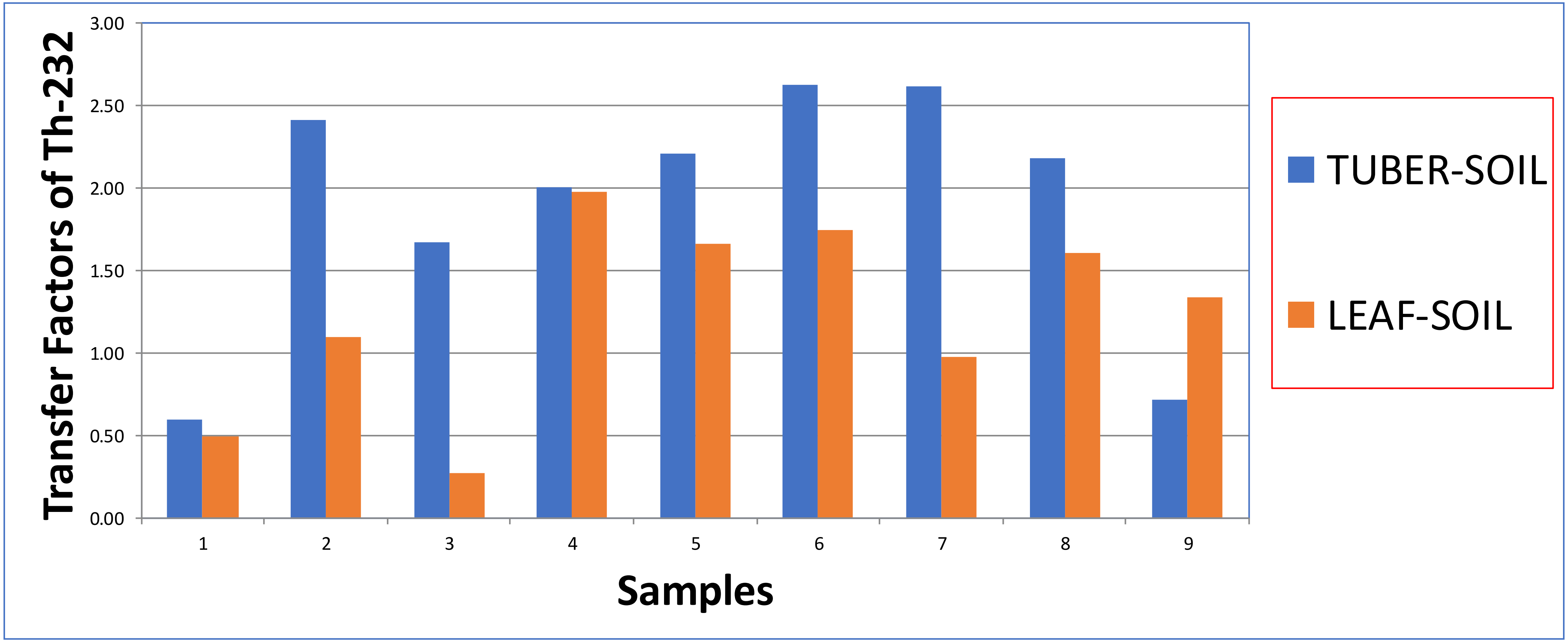
Results

Activity concentration and doses in cassava samples				
	^{226}Ra Bq kg^{-1} Mean (Range)	^{232}Th Bq kg^{-1} Mean (Range)	^{40}K Bq kg^{-1} Mean (Range)	Doses (mSv y^{-1})
Cassava tubers	40 ± 5 (7±0.2-78±3)	105 ± 13 (37±4-166±39)	459 ± 13 (201±3–96±12)	3.5 ± 1.2 (1.7 – 5.3)
Cassava leaves	41±6 (10±0.4-96 ± 3)	68±9 (18±2-105±24)	484±41 (227±5-870±27)	0.75 ± 0.3 (0.37 -1.2)
Soil Samples	41±17 (21-103)	59±4 (41-99)	594±12 (108—138)	

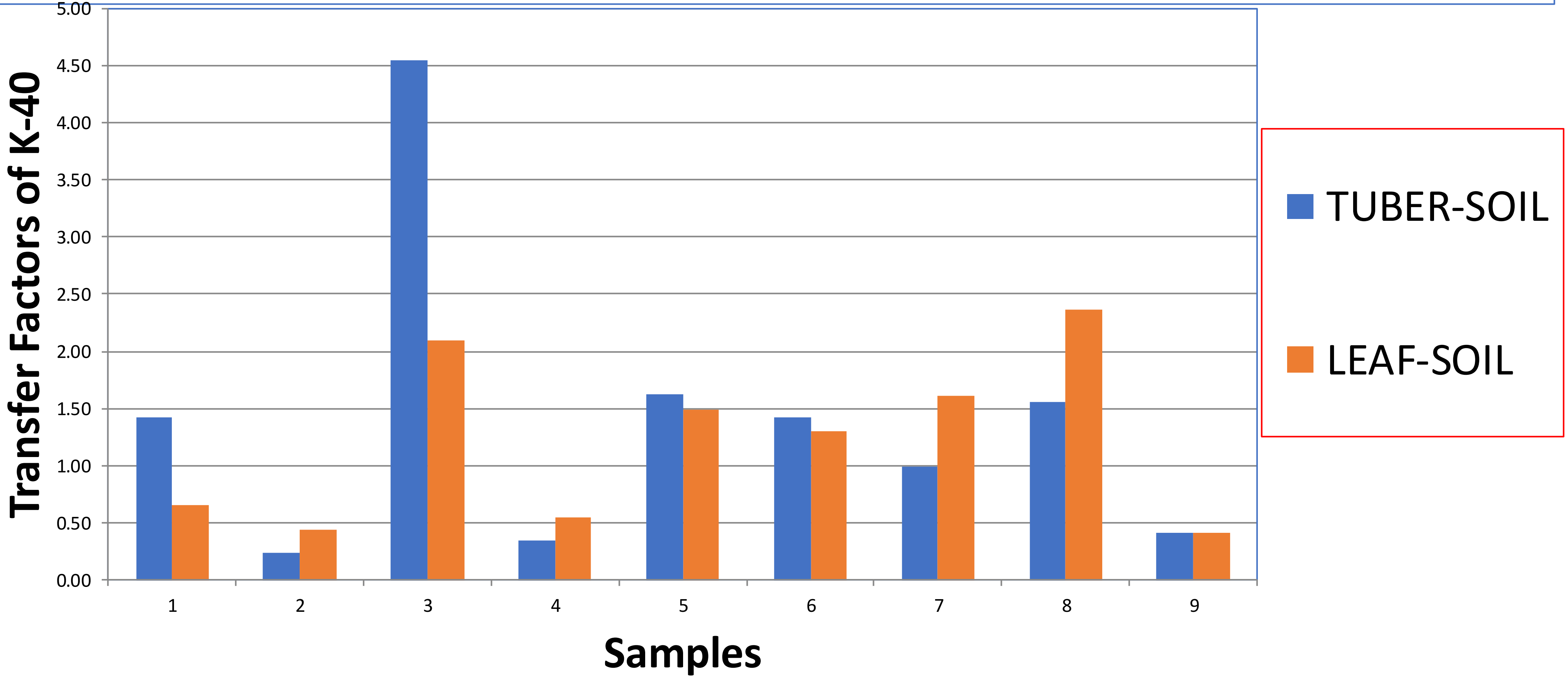
Transfer factors: Ra-226



Transfer factors:Th-232



Transfer factors: K-40



Conclusion

- The doses received from consumption of cassava tubers and leaves was 3.45 ± 1.20 $mSv\ y^{-1}$ and 0.75 ± 0.30 $mSv\ y^{-1}$ giving a total of 4.25 ± 1.24 $mSv\ y^{-1}$
- Th-232 had the Highest mean transfer factor in tubers
- Ra-226 had the highest mean transfer factor in leaves

Recommendation

Determine concentration levels of radionuclides in other types of food crops in the region.

Acknowledgement

- African Development Bank through the ministry of Education through Kenyatta University.

- Village elders and residents who assisted in sample collection

THANK YOU