

*NORM-IX Symposium, Denver, Colorado, 23-27 September, 2019*

# **Assessment Of Natural Radioactivity in Petroleum Waste from Oil Fields in Ghana**

**D.O. Kpeglo<sup>1, 2, 3\*</sup> J. Mantero<sup>1</sup>, E.O. Darko<sup>2, 3</sup>, E. A.  
Amoatey<sup>2</sup>, G. Manjón<sup>1</sup>, I. Vioque<sup>1</sup>, R. García -Tenorio<sup>1, 4</sup>,**

*<sup>1</sup>Department of Applied Physics II, E.T.S.A., University of Seville, Seville, Spain*

*<sup>2</sup>Radiation Protection Institute, Ghana Atomic Energy Commission, P. O. Box LG80, Legon-Accra, Ghana*

*<sup>3</sup>Graduate School of Nuclear and Allied Sciences, University of Ghana, P. O. Box AE1, Kwabenya-Accra, Ghana*

*<sup>4</sup>Centro Nacional de Aceleradores (CNA), Seville, Spain*

# Introduction - Background (1/2)

- Over the last decade some **Oil Explorations** and **Exploitation** activities have started at different sites along the **west coast of Ghana**.
- Consequently, **environmental concern** has appeared in association with possible chemical **pollution**
- In addition, radiometrical characterization becomes relevant in oil extraction, as NORM in the Oil and Gas Industry **presents a considerable waste issue**.

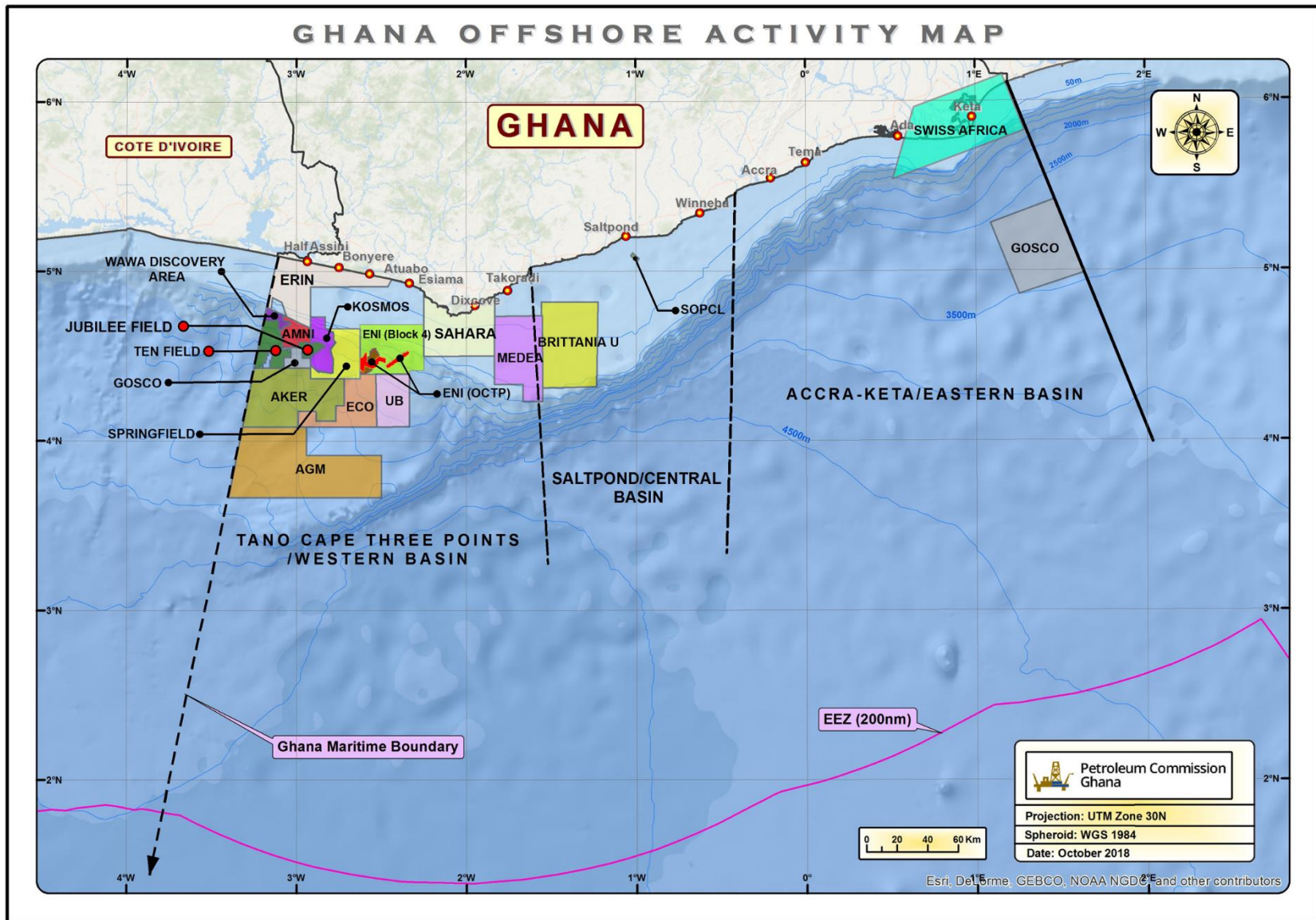
## Introduction - Background (2/2)

- The **primary aim** of the research conducted was to:
- **Assess** the radiological impacts **of NORM waste** generated and discharged from the oil fields of Ghana
- Analyse and evaluate different safe waste management options in relation to the NORM wastes generated and **discharged by the Oil and Gas Industry** in Ghana.

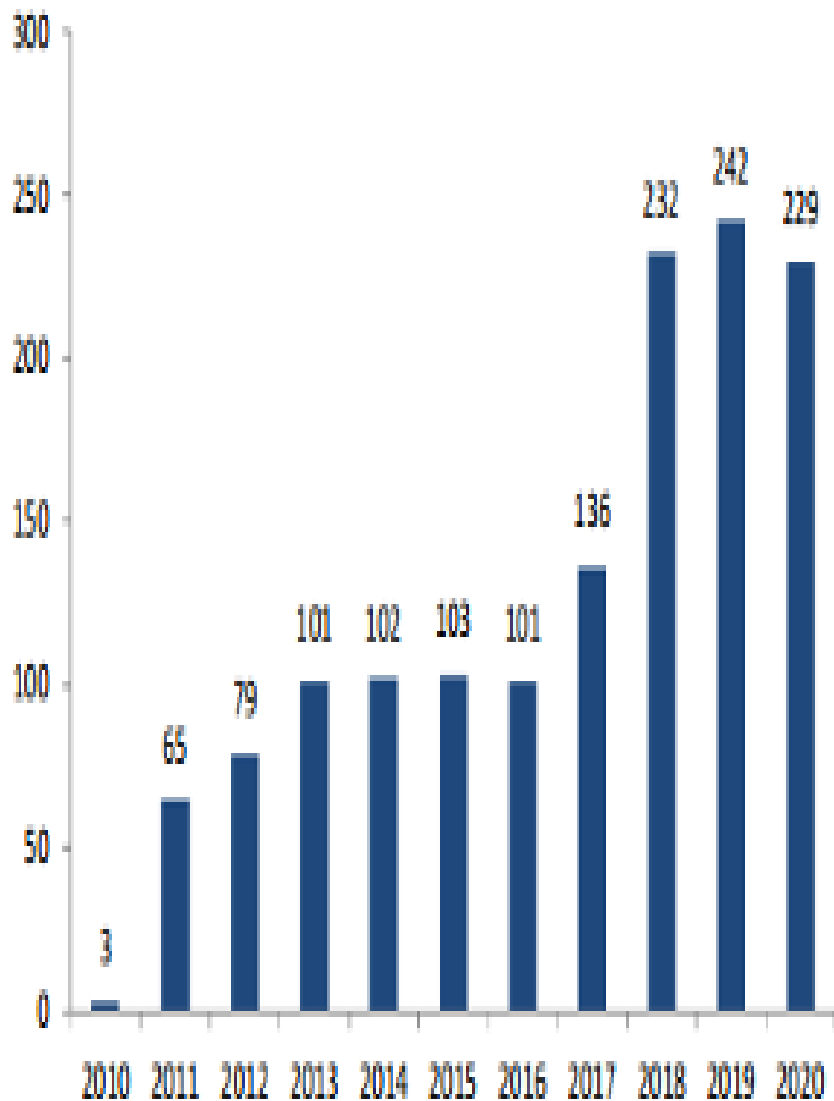
# Research conducted so far

- Preliminary findings from the research showed that NORM waste (**Produced water, scale and sludge**) generated from the **oil fields of Ghana posed significant radiological risk** to workers, public and particularly the **marine environment** and its inhabitants if waste is not well managed.
- These findings from the research conducted becomes even more important with **increasing exploration and production activities** in the oil fields of Ghana as well as associated increase in NORM waste generation.

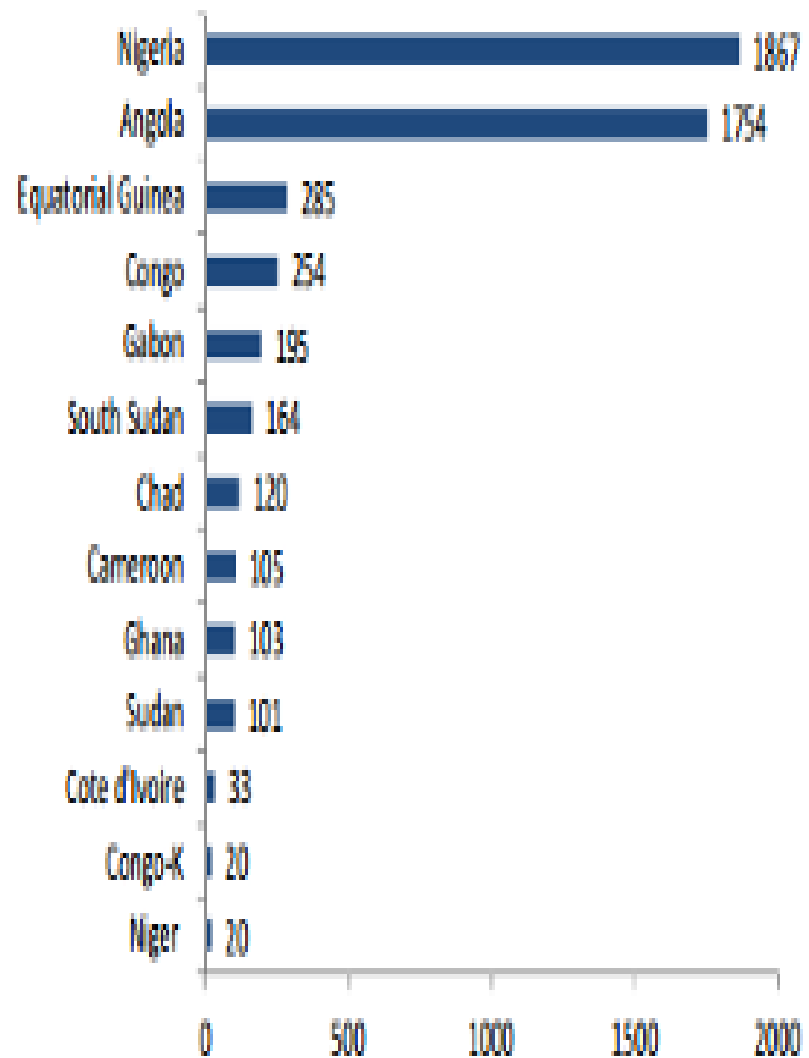
# Fig. 1: Ghana offshore activity map (PC, 2019)



### Chart 1 - Ghana oil output projection



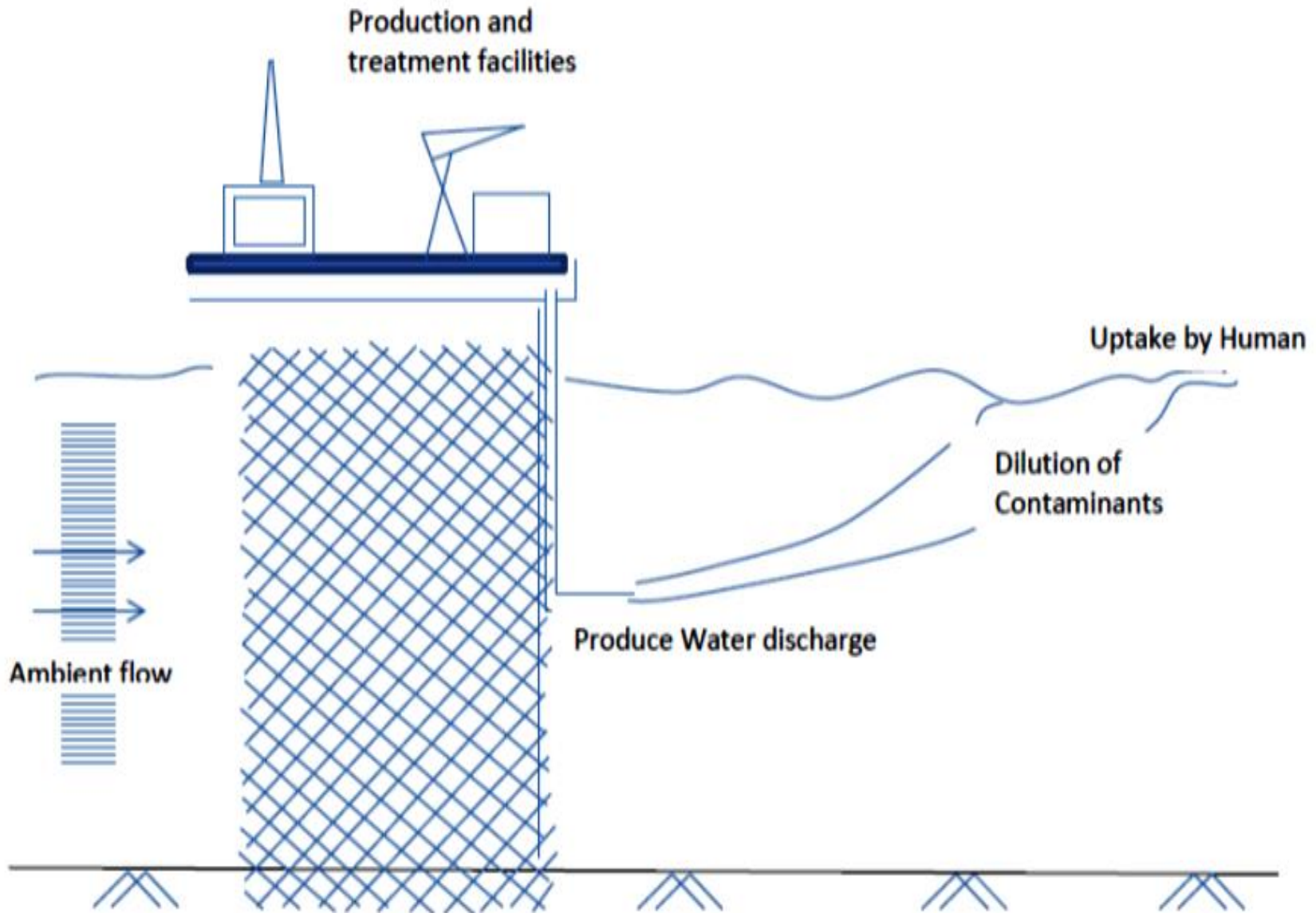
### Chart 2 - Top oil producers in Sub Saharan Africa



# Exposure pathways considered

- Workers:
  - Direct gamma radiation exposure
  - Radon inhalation
- The public:
  - Direct gamma radiation exposure
  - Exposure to radon
  - Ingestion of contaminated water sources (surface water {e.g. rivers, streams, etc} and ground water {e.g. boreholes, wells})
  - Ingestion of sea food harvested from contaminated marine environment

# Fig. 3: Exposure Pathways for Human Uptake





# Human Health Risk Assessment Model developed in this study

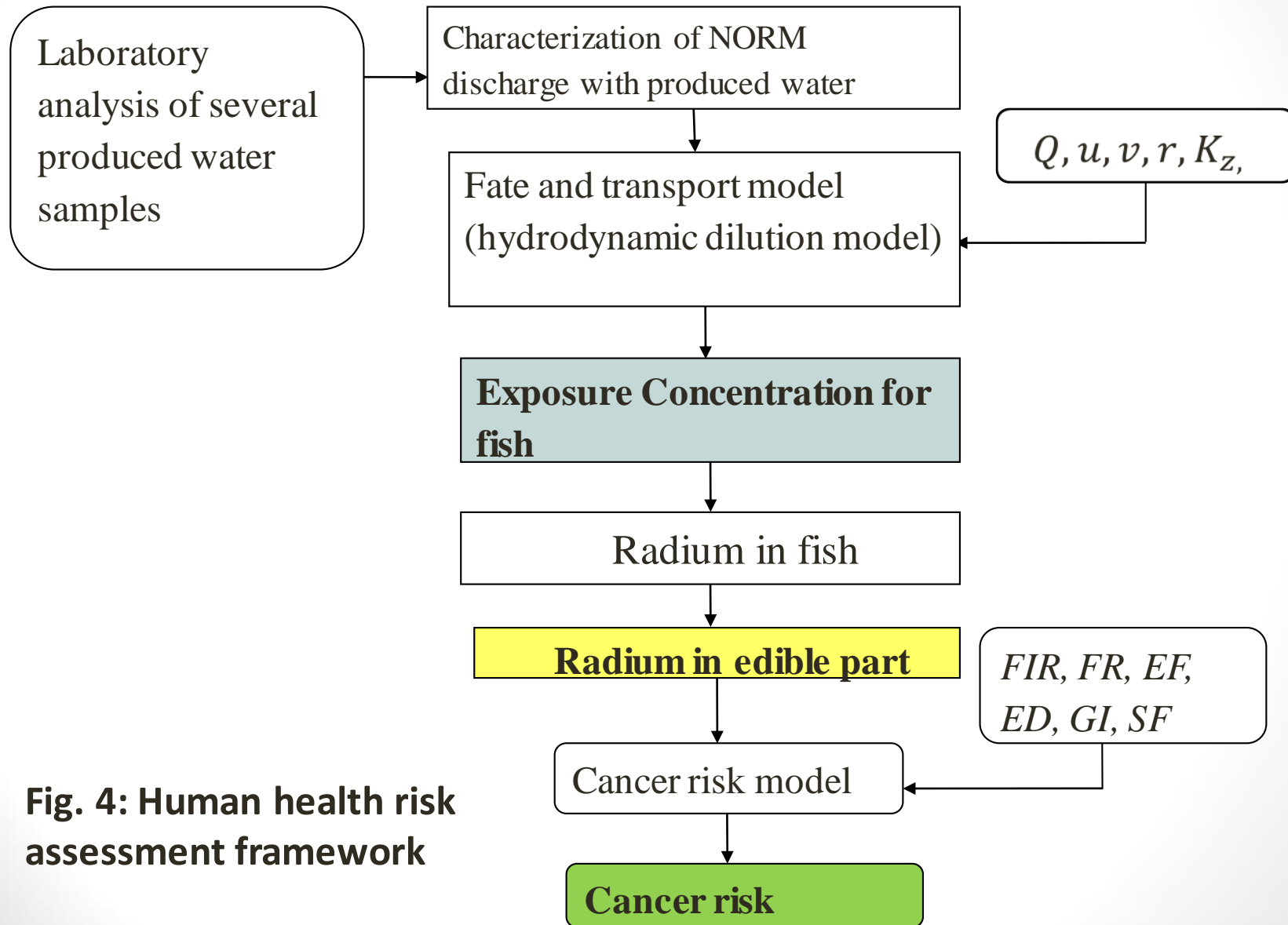
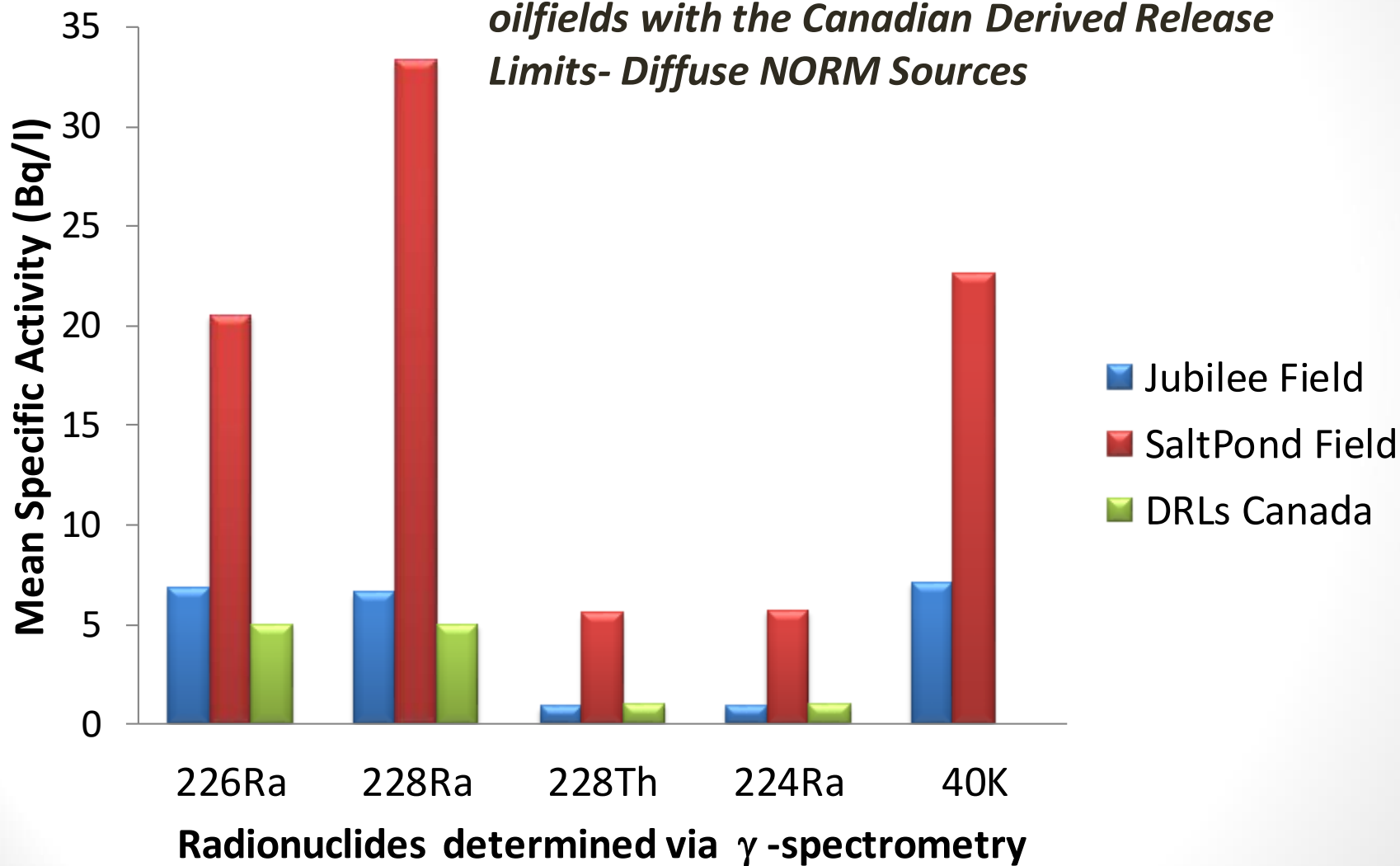


Fig. 4: Human health risk assessment framework

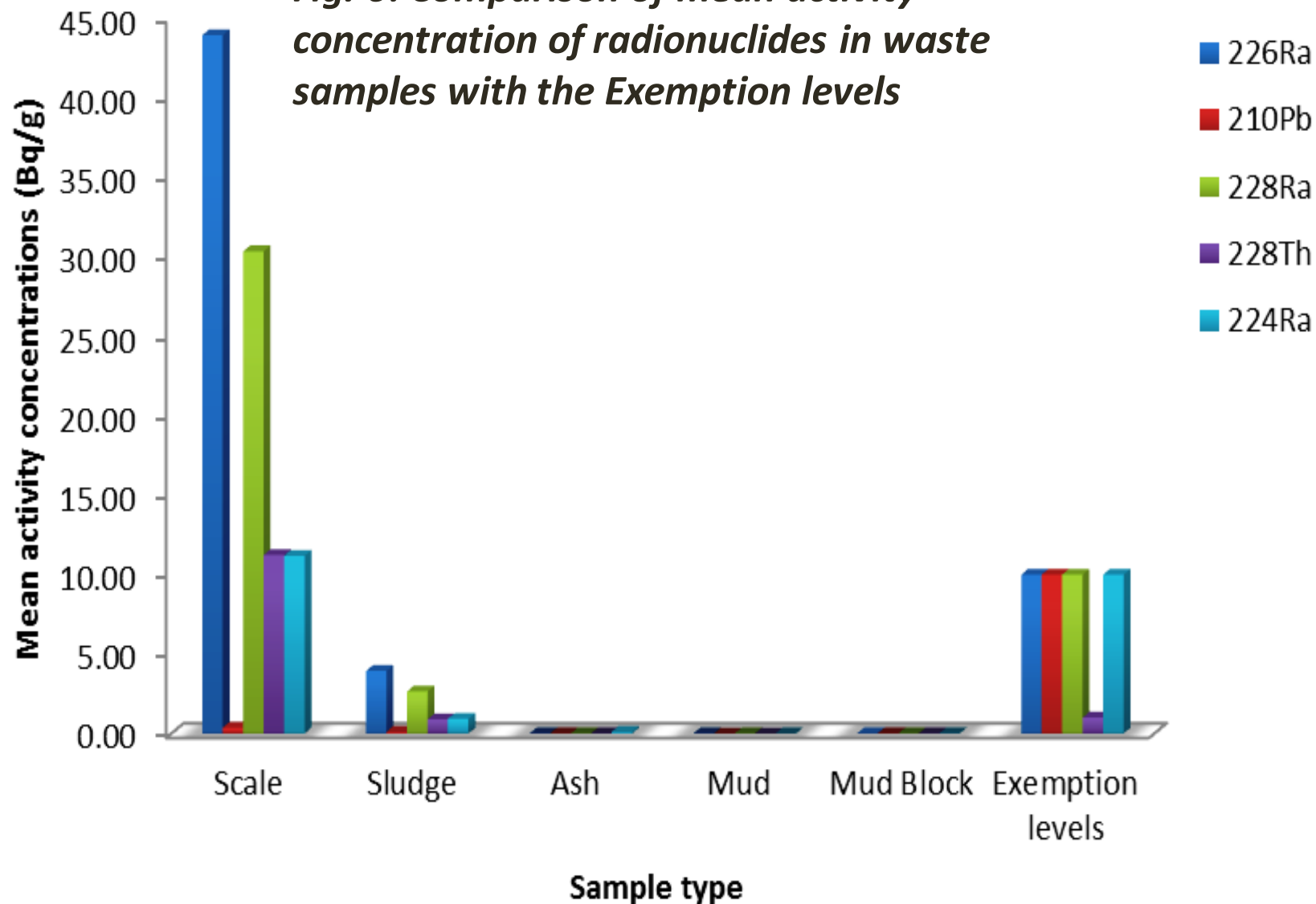
# Results and Discussions- Produced water

*Fig.5: Comparison of mean activity concentration of radionuclides in produced water for Ghanaian oilfields with the Canadian Derived Release Limits- Diffuse NORM Sources*

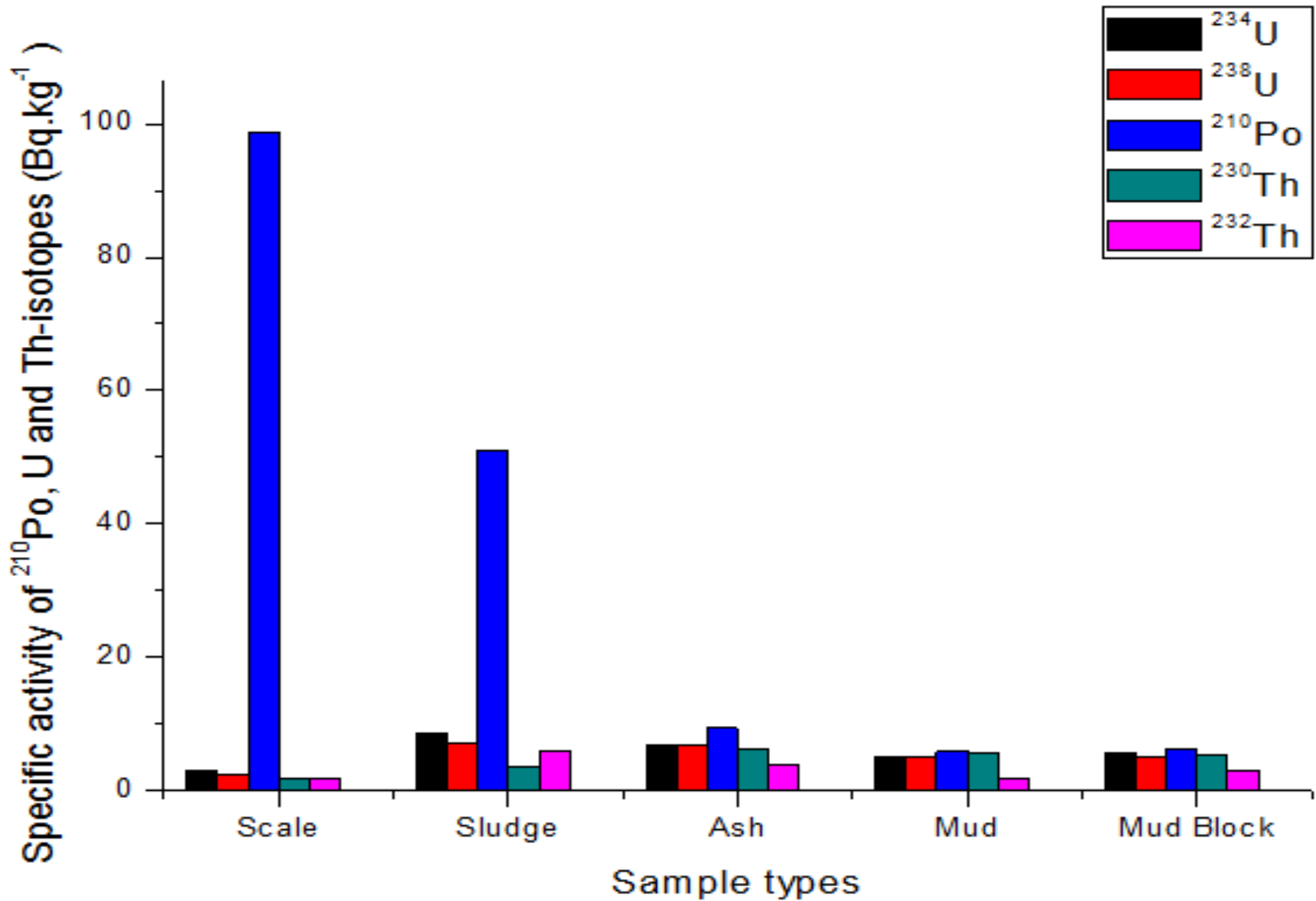


# Results and Discussions- Solid NORM waste

**Fig. 6: Comparison of mean activity concentration of radionuclides in waste samples with the Exemption levels**



**Fig. 7: Comparison of mean specific activities of radionuclides in waste samples via  $\alpha$ - spectrometry**



# Regulatory regime and NORM waste Mgt. in Ghana

- Currently there are **no specific guidelines** on **discharge of NORM waste** into the **marine environment**.
- **Produced Water** which is the **largest volume of waste** generated, and is **discharged based on its oil in water** content limit and **not the Radionuclides** content and this situation could pose risk to the public as seafood contributes a major component of the public daily diet.
- It was also evident from the research conducted that, **Oil and Gas Waste Management System** currently available in Ghana **excludes major NORM related issues** and as such the approved Oil Waste Management Companies **may not have capacity** to handle potential NORM waste such as Scale, sludge and produce water.

# National Mitigation efforts

- Efforts to **provide efficient and sustainable Technical Management and Consultancy Services for safe NORM waste management** generated from the Oil and Gas Production and Exploration in the territories of Ghana and neighbouring countries in the Oil and Gas Industry is being looked at with existing waste management companies.
- Investment opportunities to partner local infrastructure are possible

# Technical Services for NORM waste needed includes:

- Radiation Safety/Impact Assessment,
- NORM Waste Testing,
- Decontamination of NORM waste,
- Safe Disposal of NORM waste, and
- Safe Handling/Transportation of NORM waste
- Occupational Radiation Safety Training for technical workers in the Oil Industry

# CONCLUSION

- This study will assist in several national efforts to set up of appropriate national guidelines for the management of NORM waste from the emerging oil and gas industry in Ghana.



# Acknowledgements

- This work was funded by the International Atomic Energy Agency in the form of an 18 months Sandwich Fellowship and the Radiation Protection Institute of the Ghana Atomic Energy Commission (fellowship grant Number GHA/14019).
- Ghana National Petroleum Corporation, Tullow Ghana Limited and Saltpond offshore producing company limited for their support
- Department of Applied Physics II, University of Seville through IAEA collaboration

# Thank you

