

## DESIGN AND DEVELOPMENT OF A GEO-REFERENCED DATABASE TO RADIONUCLIDES IN FOOD

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### Abstract

The primary purpose of the range of activities concerning the info management of the environmental assessment is to provide to scientific community an improved access to environmental data, as well as to support the decision making loop, in case of contamination events due either to accidental or intentional causes. In recent years, geotechnologies became a key reference in environmental research and monitoring, since they deliver an efficient data retrieval and subsequent processing about natural resources. This study aimed at the development of a georeferenced database (SIGLARA – **S**istema **G**eoreferenciado **L**atino **A**mericano de **R**adionuclídeos em **A**limentos), designed to radioactivity in food data storage, available in three languages (Spanish, Portuguese and English), employing free software (NASCIMENTO, 2014).

**Keywords:** Data base, radionuclides, food.

### 1. INTRODUCTION

The consumption of contaminated food is considered as the ultimate factor to the intake of radionuclides by the human body. As a consequence, studies are being carried out worldwide, aiming the assessment of both toxic elements concentrations in food and maximum permissible amounts to human consumption. In terms of health effects, some features must be taken into account, such as identification and intake levels of the absorbed radionuclide(s). In a follow up study, levels of toxic elements in human diets must be monitored and the intake of the related food items continuously evaluated, in a way that a specific database can be provided to

further comparisons to reference limits established by public health organizations.

Through the *Codex Alimentarius* Commission, the World Health Organization (WHO) sets out limit week values for tolerable ingestion of toxic or potentially toxic elements, based upon the maximum lifetime ingestion exempt of significant health risks, being all known concerned facts taken into account.

The Food and Agriculture Organization (FAO/WHO) is responsible for advising member nations on a broad range of parameters affecting relevant topics as agriculture, food production, processing, storing and trading, including the

compliance with regulations referred to food quality and safety (RANDELL, 2004).

The United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) comprises the scientific body of WHO, in charge of producing reports approaching overall radiation levels and effects related to exposure to ionizing radiation.

The International Atomic Energy Agency (IAEA) is the WHO branch responsible for setting and disseminating protection and safety standards for ionizing radiation, as well as ensuring the peaceful use of nuclear activities.

IAEA puts a strong emphasis on environmental and public protection and many countries established an independent public supervisory authority responsible for monitoring ionizing radiation deployment, preventing radiological and nuclear accidents, as well as evaluating the impact on society.

In Brazil, such duties are delegated to the National Nuclear Energy Commission (CNEN) (SILVA, 2007).

Since the Chernobyl accident in 1986, a mandatory radiological certificate is required in export documentation of food by nearly all importing countries. As a consequence, a comprehensive assessment of radioactive background levels in food items produced worldwide can be useful to such business segment, as well as to scientific society.

Though a growing interest in the dynamics of extensive access and exchange of reliable data and environmental information is arising, simultaneous concerns regarding the strategies to accomplish such tasks – deployment costs and

difficulties in the access of new technologies included – are evident too.

The primary objective of the management of an information database related to the environmental assessment is to provide an upgraded data and relevant information access to world community, both as a tool in the decision making process, in case of contamination arising from either accidental or purposeful reasons and to fulfill the documentation requirements regarding food exporting in the international market.

## **2. MATERIALS AND METHODS**

### ***2.1. System Scheduling***

Methods were split up in six stages, as follows:

- Database setting and validation;
- System development tools settings;
- Modelling and database creation;
- Use case diagram;
- System development;
- Logo and login page design.

### ***2.2. Tools***

In order to accomplish this project, reliable software is requested to ensure the safe achievement, storage, management and display of data.

It must be emphasized, though, that all tools used throughout the different stages of this study meet the free distribution paradigm, which gives a particular feature to the system.

The development and use of free software based systems have been strongly encouraged by government agencies, aiming the cost reduction and the settlement of a program installed base,

with the adoption of measures to avoid the illegal use of computational programs.

SIGs are defined as multitasking computational tools, that is, they can be used by diverse users communities. However, most of SIG's adopt third party software interface infrastructures and such approach can frequently lead to interaction problems with users.

Some practical expectations are supposed to be met by the deployment of this system. The interface is simple, intuitive and interactive, being assumed that users do not necessarily have a previous practical experience or theoretical background regarding software and tools in database development, modelling and setting.

The most relevant tools used in the development of the SIGLARA system are mentioned as follows, being free distribution attended, whenever feasible:

LINUX operating system, responsible for the computer performance, connecting hardware (printer, monitor, mouse, keyboard) to software (application programs in general).

APACHE server for the interaction between client and server, by means of protocols like the *Hyper Text Transfer Protocol* (HTTP), which standardizes data input and output, regardless of the platform. APACHE server was chosen due to some positive aspects. It is a free web server, provides versions to several operational systems, as well as a convenient installation. Furthermore, APACHE offers a practical file setting, which allows further settings without a following mandatory server reboot.

The implementation of a database requires the choice of a database management system (DBMS) with Structured Query Language (SQL) as interface. The most popular open code database worldwide, MsSQL meets such

prerequisite, besides all further key requirements for a DBMS, like strength, safety and reliability, providing a high performance affordable supply of reliable database applications, based upon web.

An applicative development platform that generates PHP (*Hypertext Preprocessor*) codes and is compatible with all web navigators, SCRIPTCASE was deployed as a development tool in the interface implementation process. PHP is a wide range programming language, remarkably efficient to web developments, in so far as it allows developers to write pages supposed to be dynamically generated later.

Google Earth is a free program developed and issued by Google, that enables the user to "flight over" a terrestrial globe 3D tridimensional model, with high-resolution graphics and designed from satellite images from several sources, aircraft pictures and SIG 3D.

In that way, it can be used basically as a satellite images and bi-dimensional maps generator, as well as a simulator of several landscapes on Earth. Hence, Google Earth allows the identification of places, buildings, cities, monuments, geographical features, etc. Google Earth is similar to another Google product, Google Maps, though more complex. Both are designed on the same foundations: high resolution pictures from all feasible and available places, taken by satellites and private airplanes, hired by Google.

### 2.3. Database Design

In this study, an approach based upon data representation in the relational model was adopted. The entity-relation model has the perception of the real world as a cornerstone, conceiving such real world as a set of primary objects named entities and their interactions.

This methodology was formerly proposed by Dr. Peter Pin Shan Chen in 1990 (CHEN,1990), as a tool to facilitate the modelling of a database project, in order to enable the data knowledge of an information system.

The system is laid out in tables, which join together under specific relation rules. Such rules consist of correlating a feature of a table with a tab strip from another table, by means of the inclusion of table key field.

### 2.4. System features

Table 1 shows a further explanation about the system features .

Table 1 System Features

Name	Descripcion
Register Sample	Inclusion, alteration, exclusion, consultation and printing the analyzed data of samples.
Register Sample Measurement	Inclusion, alteration, exclusion, consultation and analyzed data of radionuclides .
Register FAO Group	Inclusion, alteration, exclusion, consultation and printing the analyzed data of FAO Group .
Register Food Group	Inclusion, alteration, exclusion, consultation and printing the Food Groups.
Register Food	Inclusion, alteration, exclusion, consultation and printing the data of Registers Food .
Register Radionuclidos	Inclusion, alteration, exclusion, consultation and printing the data of register radionuclides.
Register Apresentation	Inclusion, alteration, exclusion, consultation and printing the data of sample apresentation.
Register FAO Zone	Inclusion, alteration, exclusion, consultation and printing the data of FAO Zone (to fish sample).
Register Categories	Inclusion, alteration, exclusion, consultation and printing the data of sample categories.
Register Laboratories	Inclusion, alteration, exclusion, consultation and printing the data of laboratories that analyze the sample.
Register Units of Measurement	Inclusion, alteration, exclusion, consultation and printing the units of measurement.
Register Countries/States	Inclusion, alteration, exclusion, consultation and printing the Countries and States Registers in the System.
Register Groups and User of System	Inclusion, alteration, exclusion, and consultation of the System users and association with the appropriate profile.
Confer and Generate Sample Map	On line consultation of data and generate maps.

## 2.5. System tables

The database comprises a set of tables, as can be seen below in Table 2.

Table 2 Tables of System

Name of Table	Description
Sample	Register sample.
Measurement	Concentrations of the radionuclides in the sample.
FAO Group	FAO Food Group.
Kind of Food	Food Group.
Food	Food analysed.
Radionuclido	Registered Radionuclides.
Apresentation	Presentation of the sample: acidified, frozen, bottled, refrigerated, packed or has no.
FAO Zone	Mapping of FAO's fishing zones.
Categories	Sample categories: natural or industrialized
Laboratories	List of laboratories accredited for sample analysis.
Units of Measurement	Units of measurements of radionuclides analyzed, such as: Bq/m <sup>3</sup> , Bq/L, Bq/sample, Bq/kg, Bq/kg dry, Bq/kg wet and Bq/kg gray.
Methodologies of analyses	Sample analysis method.
Countrie	Countries (initially from Latin America).
State	States (initially from Latin America).
User Group	User profile of the system, such as: Country Administrator, Technical Manager (Informatics), Technical User and User (for consultation only).
Solicitations	Request new users.
User	System users.
LogSystem	It is the registry of the main movements of the users in the system. It serves to record all the history of navigation by the system made by the users.

## 3. CONCLUSIONS

The objective of the present study was the attainment of a georeferenced database through a Geographic Information System (SIG), in order

to support incorporation and storage of radionuclides levels data in food issues.

On the basis of the dataset obtained in the development of this project, the key features of the system can be quoted below.

- Creation of a georeferenced database;
- Development of an information system aiming the storage of data related to the occurrence of radionuclides in food;
- Standardization and storage of analytical data from samples;
- Setting of food and radionuclides tables;
- Convenience of data manipulation within the system scope, such as insertion, modification and deletion;
- Deployment of consultation mechanisms and reports access facilities aiming the provision of information to system users;
- User convenience of database info download and backup in the PDF or XLS formats (electronic worksheet).

The SIGLARA system can be defined as an application program designed and developed to embody the resources that enable the remote access to data.

Employing free technologies with open source codes, like Google Earth, MYSQL (SGBD) database management system and Web Services, SIGLARA delivers a practical and efficient communication both in data exchange and system integration online.

It can be considered as objectives of SIGLARA system, too:

- (i) to provide updated information regarding radionuclides findings in food.
- (ii) to reference samples from the geographic standpoint and



(iii) to integrate the provision of information both to public and scientific communities.

The SIGLARA system is a SIG with a friendly and simple interface that simplifies the access of all users, meeting the specific requirements to the integration of the information provided by the system.

Both the design and development of the system were enabled by the adoption of public free software. The SIGLARA georeferenced database was tested in terms of feasibility, by the input and treatment of analyzed real data. It was concluded, then, that the system is capable of storing, retrieving and simultaneously processing the samples register data.

Designed to connect the users community right to the database, the structured graphic interfaces showed to be efficient, facilitating the system operation.

Along with the integration of designed procedures to data management of registered samples, the application of SIGLARA to the environmental management of radionuclides levels in food yields results already.

Such results are expected to stimulate and promote the extensive use of SIGLARA abroad, including international organisms, public and scientific communities in general, as an useful tool to a quick and safe decision making loop.

In the near future, SIGLARA can be expanded to include dose calculations from food ingestion.

System Address: <http://siglara.gov.br>

Figs 1 and 2 show some SIGLARA viewings.



Figure 1 Example map sample in the SIGLARA System

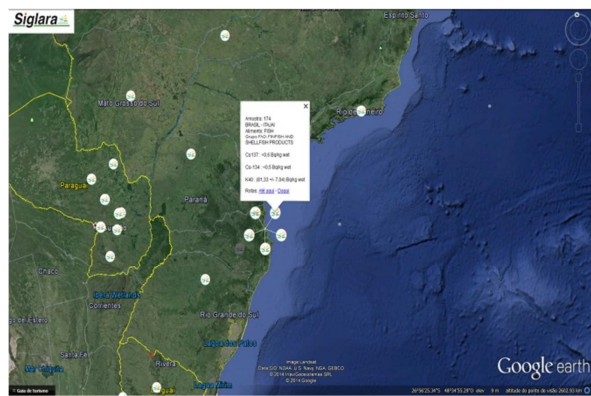


Figure 2 Example of label sample in the SIGLARA System

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