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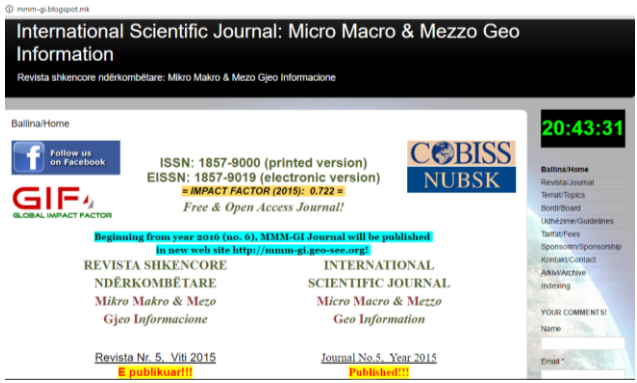

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GEOMATICS FOR DIGITAL EGYPTIAN SOILS MAPPING, CASE STUDY OF NORTHWESTERN COAST

Abd-Allla GAD[1], Mohammed HAMMAD[2] and Mohammed Bayomy ZAHRAN[3]

UDC: 528.94.067:004.9]:551.435.3(620)

ABSTRACT

The northwestern coast of Egypt is characterized by an international interest due to its history and magnificent environment, thus worth to be referred as "Bread basket" during the Greek and Roman periods. Recently, drastic changes in land use resulted in destructing many of water harvesting tools, thus diminution agriculture importance. Restoring and planning self-sufficient communities need to develop a sustainable land resources database. The medium scale space data provide a spatial resolution of 30 meters, in addition to multi-temporal imaging. Moreover, Geographic Information System (GIS) permits to store, merge, and manipulate the huge amounts of thematic maps and attribute data.

A number of 7 Landsat 8 OLI of June 2019 scenes, and 53 topographic maps at scale 1:50000, covering the whole study area, were acquired and merged. ENVI 5.1 software was used for image processing while ArcGIS 10.4.1 to generate thematic layers relevant to land resource, Field investigation was carried out to represent different soil units and collect ground control points. Chemical and physical soil properties were determined, upon which soil classification was based. Soil map was produced including dominant geographic units and soil association. The Mediterranean Land Evaluation Information System (Micro-LEIS) system was employed to define soil suitability classes for practiced cultivations.

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The results showed that the soils are generally characterized by the presence of Calcic, Petrogypsic and Salic horizons. The identified great groups include Torripsamments, Torriorthents, Haplosalids, Petrogypsids and Haplocalcids. Soils of the alluvial fans and watershed basins are deep to moderately deep. The salinity is relatively low whereas the CaCO3 content is mostly high. Land suitability limiting factors found in the piedmont and coastal plains include salinity, soil depth and texture.
It can be concluded that the digital mapping, encouraged by the progress of GIS and satellite imaging, preserve in the investment spent in soil and other thematic mapping.

Key words: Soils, Space data, GIS, Digital soil mapping, Egypt

INTRODUCTION

With the great progress in computation and information technology come vast amounts of data and tools in all fields of endeavor. Soil science is no exception, with the ongoing creation of regional, national, continental and worldwide databases. The current study aimed basically to build a georeferenced thematic database of the study area. Such databases will be a trustable ground truth resource to analyze different agro environmental aspects (e.g. environmental sensitivity to desertification). Land use/ cover were mapped, on bases of multi concept of satellite images (Landsat 8 OLI June 2019, field checks and available thematic maps).
The histogram equalization stretching process was used and resulted in the maximum contrast between features. Geomatics refers to the integrated approach of measurement, analysis, and management of the descriptions and locations of geo-spatial data.
False color composite enhanced images were produced using the combination of different spectral bands to analyze lU/LC bands. The created FCC's and their visual interpretations were used as guides for field work survey. The challenge of understanding these large stores of data has led to the development of new tools in the field of statistics and spawned new areas such as data mining and machine learning (Edeki and Pandya, 2012). In addition to this, in soil science, the increasing power of tools such as geographic information systems (GIS), GPS, remote and proximal sensors and data sources such as those provided by digital elevation models (DEMs) are suggesting new ways forward. Fortuitously, this comes at a time when there is a global clamour for soil data and information for environmental monitoring and modelling. Consequently, worldwide, organisations are investigating the possibility of applying the new spanners and screwdrivers of information technology and science to the old engine of soil survey. The

principal manifestation is soil resource assessment using geographic information systems (GIS), i.e., the production corresponding to national to global, catchment to landscape and local extents. In the language of digital soil maps, different from that of conventional cartography, scale is a difficult concept, and is better replaced by resolution and spacing (Stumpf et al., 2017).

The northwestern coast represents a promising region for extensive development both for local and expected new inhabitants. The concern of coastal resources has increasingly risen during the last two decades mainly because of the great pressure of human actions (urban expansion, industry, tourism, infrastructure, aquaculture, fisheries ports and marinas, energy production and transportation) but also due to the ineffective information, policies, planning and management tools for controlling or regulating human actions and natural processes (natural risks or hazards) in such sensitive environments as that of coastal zones.

The study area dominates the northwestern coast of Egypt between Burg El Arab and El Sallum (figure 1). It is bounded by latitudes 30o 30' N and 31o 45' N and longitudes 25o 00' E and 29o 30' E. The distance from Alexandria to the extreme east of the study area is about 390 km, while extending for some 600 km to the extreme west.

The cultivable soils in the northwestern coast are originated from transferred sedimentary rocky material. The sediments have been transported by water to alluvial fans and flood plains. Soils were formed also by Aeolian sediments in some locations. The subsoil layers are formed locally from the marine limestone. The soil depth varies according to its location, found shallow in the sloping and plateau landscape, and deep in the coastal plain and alluvial fans. The occurrence of calcium carbonates ranges from 30 to 70% and may reach 99% in the calcareous sands (Hammad et. al. 1981).

The area from the coast to the Libyan plateau includes calcareous formation belong to the Pliocene and Pleistocene covered with recent sediments. The existence of parallel ridges along the coast characterizes the area. The ridges are absent in some locations, and consist of calcareous sedimentary material differ in there coherence. The Libyan plateau occupies huge area and extends southwards (CONOCO, 1989).

The area includes a narrow coastal plain, followed at the south by a sand dune area. Southwards of the dunes, the plain rises gradually till the altitude of the plateau this reaches 50 to 150 meters above sea level. The coastal plain stretches in east-west direction, bounded by the sea to the north and the pediment plain to the south. Its width varies, controlled by the geologic formations from some meters to about 10 km. This plain mainly consists of alluvial fans, descending from the plateau, wad's extensions, rocky plains sabkhas, sand sheets and sand dunes. The pediment plain is clear between

Ras El-Hekma to Ras Alam El-Room. It is a low lying plain where rain water, descending from the plateau is collected. This area has a considerable potentiality for agriculture expansion. The plateau is rocky, covered mostly by a thin depth of soil. It plays an important role in distributing winter rainfall (FAO, 1970).

Most of the cultivable soils in the northwestern coast are alluvium. The sediments have been transported by water to alluvial fans and flood plains. However, aeolian sediments in some locations are being cultivated. The subsoil layers are formed locally from the marine limestone. The soil depth varies according to its location, found shallow in the sloping and plateau landscape, and deep in the coastal plain and alluvial fans (NARSS, 2005).

According to Egyptian Meteorological Authority, (1996) the average annual rainfall ranges between 156 – 180 mm. and the mean minimum and maximum annual temperatures are 16.4 and 23.0 C° respectively. The evaporation rates are coinciding with temperatures where the lowest evaporation rate (6.9 mm/day) was recorded in January while the highest value (8.8 mm/day) was recorded in September.

This study aims to use the remote sensing data and Geographic Information system to produce the land resources digital maps of the Northwestern Coast of Egypt, which can be used as a base for land use planning and sustainable development.

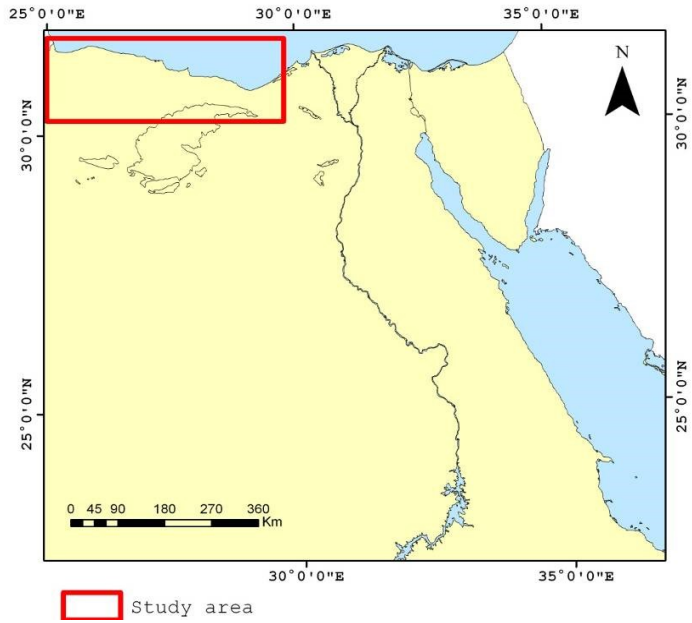

Figure (1) Location map of study area

MATERIALS AND METHODS:

This study is based on the multi concept of remote sensing data and techniques, thus, materials and methods of different sources are used as the following:

- Sven LANDSAT 8- OUI images, dated in June 2019 (i.e. 178-38, 178-39of June 15, 2019; 179-38, 179-39 of June 22, 2019; 180-38, 180-39 of June 29, 2019 and 181-38 of June 20, 2019) were used to obtain the Landsat OUI mosaic of the studied area (figure 2).
- A number of thematic maps were obtained from different sources. (eg. 53 Topographic maps of Military survey authority (MSA) at scale 1: 50000). Other maps were extracted from different sources and were input as separate layers. These thematic layers includes water bodies, altitude points, contour lines, roads, railways, tracks, pipelines, telephone lines network and mine fields distribution.
- Field missions were carried out with the purpose of collecting ground truth information concerning landscape, soil and vegetation. A number of 149 observation sites were comprehensively field studied, where different environmental parameters were described according to FAO (2006). Representative soil and water samples were also collected from different horizons for laboratory analysis using the soil survey laboratory methods manual (USDA, 2004).
- Digital Elevation Model (DEM) of the study area has been obtained from the SRTM images (figure 3).
- Rectification of studied scenes, (Landsat 8 OLI) was performed using sufficient number of GCP's, which are distributed randomly all over the images. The root mean square (RMS) error was found to be 0.74, the process was applied first on the ETM of 1990 and hence, image to image registration was accomplished.
- Arc GIS 10.4.1 software was used to create GIS coverage's from the CAD file of thematic layers. The same system was used for map features coding, editing, building topology, creating feature attribute tables FAT, edge matching and map projection. Generating check plots, compared with source maps, was fulfilled for quality assurance. This helped in detecting and editing digitizing mistakes. Join item function was used to link the tabular attributes with the spatial features.
- Arc GIS 10.4.1 software was used in data analysis, the first step in analysis began with locating the field observation sites on the thematic layers with their attributes (i.e. soils and landscape properties). Using the 3D module of Arc View the interpolation of the spatial distribution of the land

use classes was performed. Spatial analyst of Arc View was used to classify the soil parameter ranges on the map and deduct the relation between the soil conditions and the land features. Also, the 3D analyst was used for generating digital Elevation Model (DEM) from the contour lines and spot heights .The DEM creation depends on the nearest neighboring function. Statistical parameters and presentations were used to find out the relation between ground truth and image classification.

• Arc- GIS 10.4.1 software was used for this function. Landsat ETM+ images and Digital Elevation Model (DEM) were grouped and processed in ENVI 5.1 software to define the different landforms of the studied area (de Carvalho et. al., 2002 & Adam, and Gangopadhyay 2012).

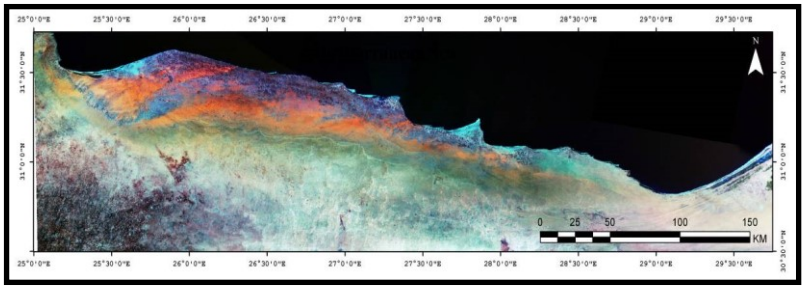

Figure (2): Landsat ETM mosaic of June 2019, covering the

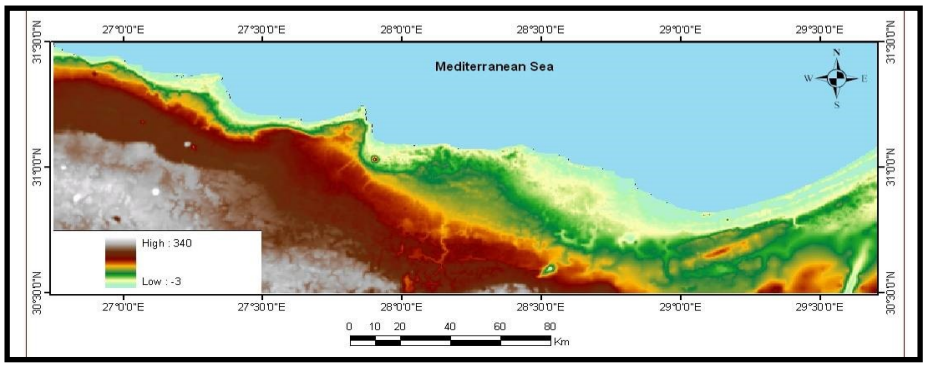

Figure (3) digital elevation model of the studied area, based on SRTM satellite mages

RESULTS AND DISSCUSSION

Producing base layers:

The planed schedule was completely fulfilled for this task, as it includes digitizing of 53 topographic map sheets. The maps performed to be available in the digital format; however their preparation as GIS ready maps has been completed. The mosaic of database layers are represented in figures (4 to 10)

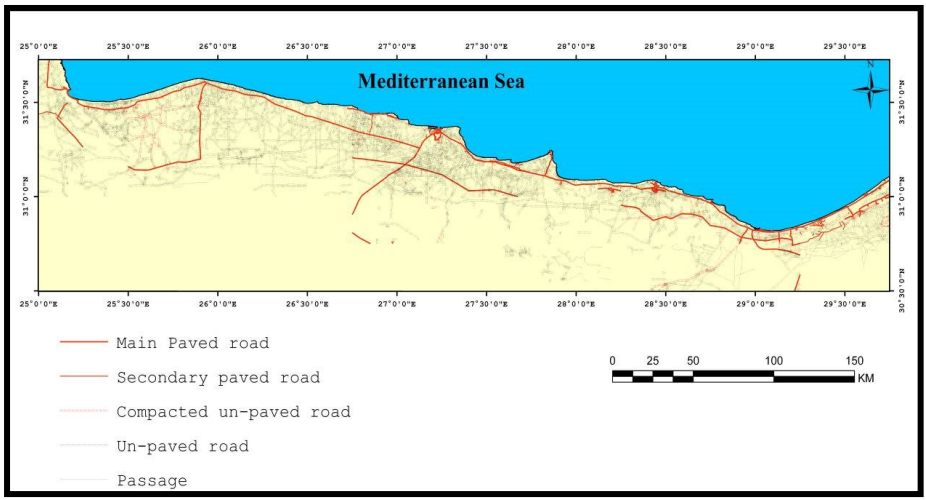

Figure (4) Roads networks in the Northwestern Coast

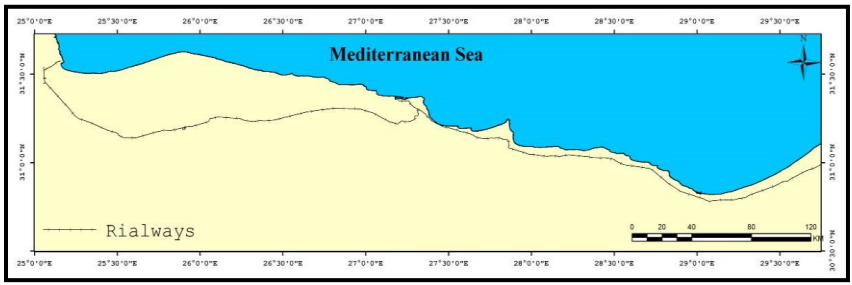

Figure (5) Railways networks in the Northwestern Coast

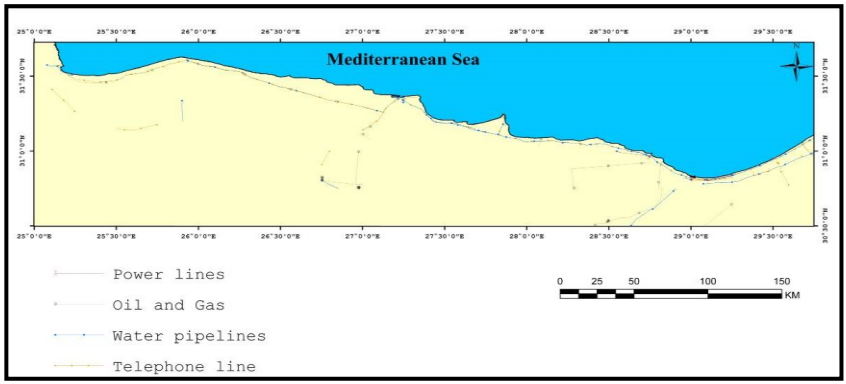

Figure (6) ***Utilities layer in the Northwestern Coast***

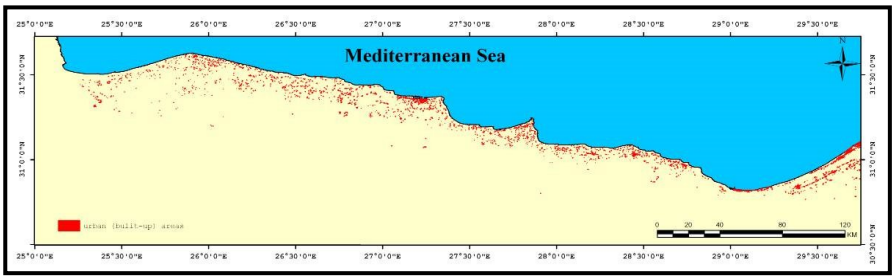

Figure (7) ***Urban areas in the Northwestern Coast***

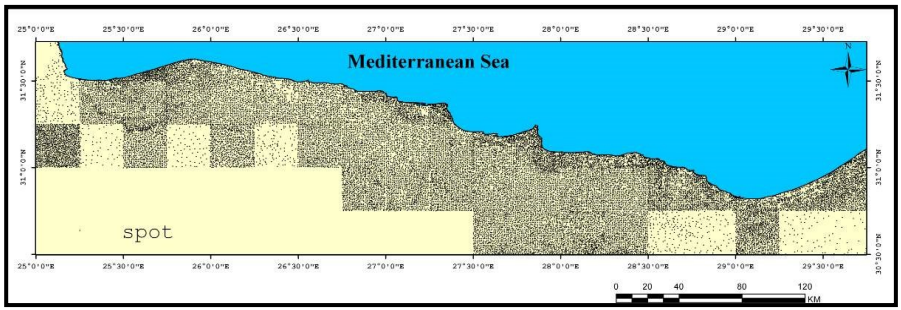

Figure (8) ***Spot heights layer in the Northwestern Coast***

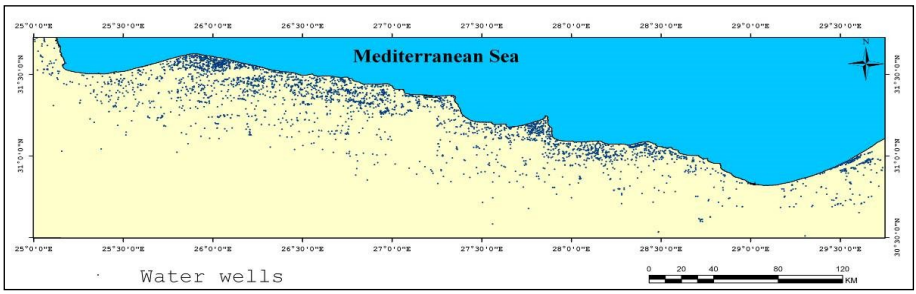

Figure (9) ***Wells distribution layer in the*** **Northwestern Coast**

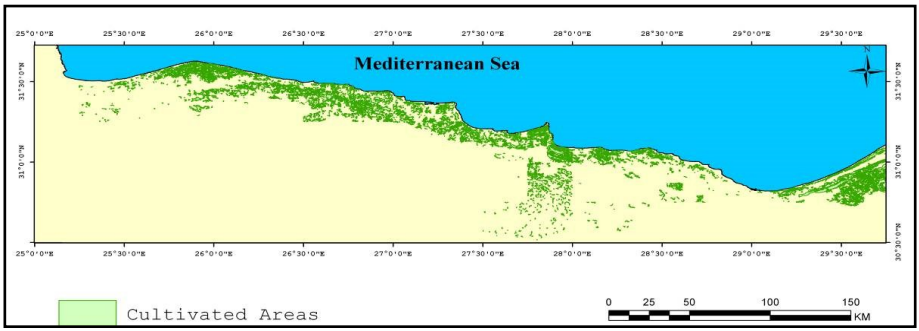

Figure (10) ***Cultivated areas in the Northwestern Coast***

Defined physiographic units of the studied area:

Physiography is assumed to be one of the driving soil forming factors and soil mapping criteria, concepts provided by this discipline can conveniently be used for soil data structuring. The combination of the geomorphic approach as a hierarchic classification system of geoforms using the existing body of knowledge in geomorphology, with the satellite data and field observations improved the results and allow using the computer-assistance procedures.

The delineation of the physiographic units from the satellite data needs a high spatial resolution images; therefore the spatial resolution of the used Landsat ETM+ was enhanced through the data merge process. This process is commonly used to enhance the spatial resolution of multi-spectral datasets

using higher spatial resolution panchromatic data or single band (band 8). In this study merged data were performed using multi-spectral bands (28.50 m) as a low spatial resolution with panchromatic band 8 of ETM+ satellite image as a high spatial resolution (14.25 m) resulting in multi-spectral data with high spatial resolution (14.25 m). The enhanced image was draped over the Digital Elevation Model (DEM) of the area to delineate the physiographic map. The physical and chemical analyses of the studied soils were linked to the attribute table of the mapping units.

The physiographic description of the investigated observation sites shows that the relief in the study area ranges between almost flat to slope, while the lithology varies from marine deposits in the coastal plain to Aeolian deposits in plateaus landscape and colluvium in the basins, terraces and slope ones. The dominant land cover is sandy sheets in the coastal plain. Scattered areas are cultivated with figs and olives trees in both coastal plain and plateau. Gravel surface and low dense shrubs exhibit the plateau, while highly dens shrubs exist in the basins. Boulders and stony fragments often exist in the ggraphy aently sloping areas. It should be highlighted that the morphometric analyses agree with (Abou-Shleel et. al. 2020) who referred that the geomorphology of the study area is characterized by the presence of Coast units (i.e. Coastal plain bordered by the Mediterranean Sea to the north and by the plateau to the south, controlled by the geologic formation. It is found that the altitudes in the coastal plain ranges between 12 and 19 meters a.s.l., while in the plateau ranges between 92 and 185 meters a.s.l. Figure (11) represents the different physiographic units in the studied area; the obtained data reveal that the area includes three main landscape units as the following**:**

- **COASTAL PLAIN:**

This type of landscape is found near to the coast of the Mediterranean Sea and includes different types of land forms such as sand sheets, terraces, vales and basins. It is characterized by the low elevation as the elevation differ from zero to 20 m a.s.l. the elevation increases generally in the southern parts of the costal plain. This type of landscape contains sand and colluvial deposits with almost flat to gently undulating relief type.

- **PIEDMONT:**

This type is located between the plateau and the coastal plain and has an elevation ranges between 20 to 65 m a.s.l. The main land forms in this type

of landscape are terraces, basins and sand sheets of gently slopping to undulating relief type.

- **PLATEAU:**

The plateaus are found in the south of the study area and have an elevation ranging from 65 up to 275 m a.s.l. and characterized by the limestone deposits as desert pavement and rock outcrops. It was possible to confirm that the rocky surfaces exhibit the plateau landscape. It was found that the surface relief of the plateau type differs from almost flat to undulating relief.

The detailed description of the landscape, relief, lithology, land forms and laboratory analyses are attached to the attribute table of the physiographic digital units (figure 12). The cultivations in the investigated area are wheat, barley, figs and olives trees as rain fed cultivation. The cultivated lands are found in the coastal plain and large parts of the piedmont because of the relatively high amount of annual rains and the absence of rock outcrops. The cultivation activity is found in the vales, basin, terraces and sand sheet area. The grazing activity is found in different areas depending on the density of the natural vegetation.

Compilation of digital soil map:

The northwestern coastal region attracted the attention of several investigators and with the advantages of satellite images of the earth, reviewing of the previous work was necessary. In view of available resolution (30m) and on regional scale, the soil maps produced formerly were modified (FAO 1970, el shazly 1978 and Hammad et. al. 1981).

Since 1960, several researchers of the Desert Institute studied separate parts. Most of there studies were accomplished by aerial photo interpretation. The modern technique at that time provided an adequate and excellent tool as base maps and for interpretation. The soil maps presented were highly predictable and credible.

The current study proved great correspondence with previous findings, as proved that e soils of the region are highly calcareous as the dominant rock is limestone. However; existence of sandstones and shales is reported, the following origins of these soils were identified as follows;

1. Marine origin for the oolitic sands of the ridges and dunes either consolidated or loose.
2. Alluvial and /or fluvio-marine origins, for the soils of the coastal plains, alluvial fans and depressions
3. Lacustrine origin for the sediments of lagoons and the deep lagoonal deposits

4. Aeolian origin for the sand dunes, hummocks and sheets of some tracts along the region.

The soils of the studied region are classified according to the Soil Taxonomy, Table (1) and figures (13) show the geographical distribution of soil units in the Northwestern coastal region. Both *Aridisols* and *Entisols* soil orders are found covering 42.1 and 57.9% of the mapped soils respectively. The *Calcids* sub-order is mostly clustered in areas of Burg El-Arab, Marsa Matrouh and Sidi Barani exhibiting 14.45% of the area. The *Salids* sub-order exists around both Matiout and Salum lagoons representing an 6.11% of soils The Gypsids sub-order soils is restricted in the area between El-Hammam and Sedi Heneish covering 21.54 % of the maped soils.

The *Entisols* soil order includes the sub-orders *Orthents* and *Psamments* representing 33.99 and 23.91% of the mapped soils respectively. It can be noticed that the area from Burg El-Arab to Matrouh is characterized by variability of soil units (e.g. *Torripsamments*, *Torriorthents*), while the area from Matrouh to El-Saloum is occupied by the *Torriorthents* great group soils.

Khalifa and Beshay (2015) indicated that ten soil mapping units were differentiated at West of Matrouh, Northwestern Coast of Egypt according to differences in profile depth, texture and topography. Integrated data emphasized that 13.6% and 19.6% of the total area, respectively have deep and moderately deep profile depth. Coarse to moderately coarse texture classes dominated whole soils. Almost flat topography to gently undulate conquered the area over 69.3%.

Based on field check and laboratory analysis, soils were classified into 10 family classes, while at sub great group level seven classes were differ (i.e. *Typic Torrifluvents, Typic Torripsamments, LithicTorripsamments, Lithic Torriorthents, Oolitic Torripsamments, Typic Aquisalids and Typic Haplosalids* exhibiting 15.2%, 18.0%, 22.6%, 35.7%, 5.0%, 3.5% and -0.15% of study areas, respectively**).**

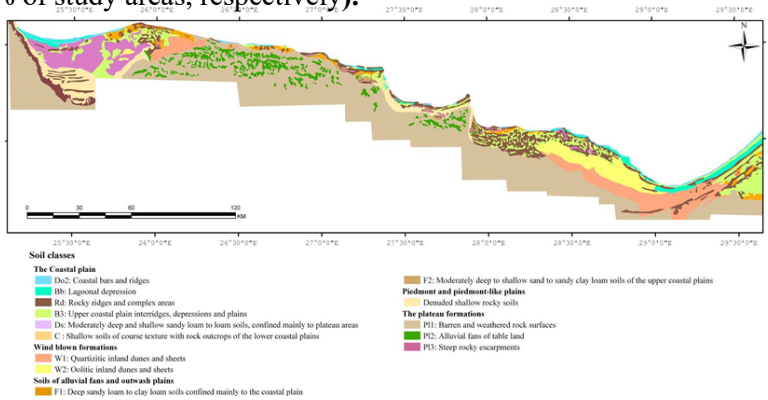

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Figure (11) M*ain physiographic units in the Northwestern Coast*

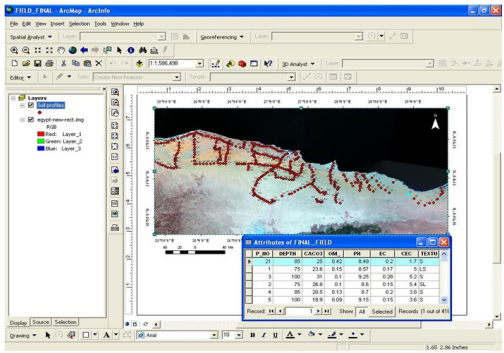

Figure (12) Physiographic digital units and related attribute table

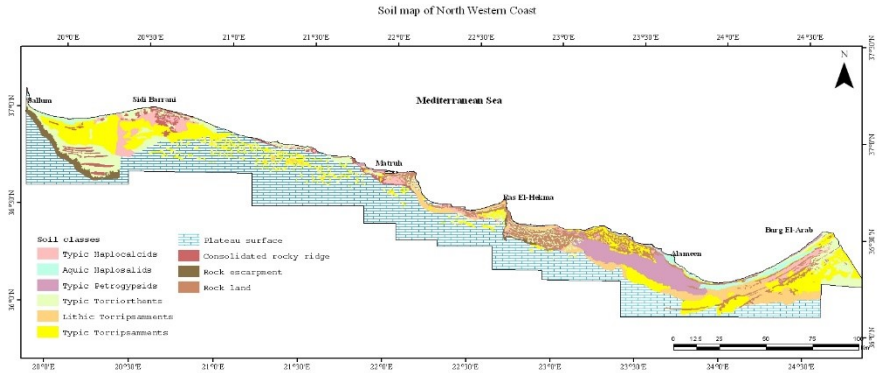

Figure (13) ***Soil map of the North Western Coast region***

Table (1) Areas of sub-great groups, in the Northwestern coast of Egypt

Order	Sub-Order	Type (Great group)	Area (Km2)	%
Aridisols	*Calcids*	*Haplocalcids*	542.17	14.45
	Salids	*Haplosalids*	229.4	6.11
	Gypsids	*Petrogypsids*	808.45	21.54
Entisols	*Orthents*	*Torriorthents*	1275.57	33.99
	Psamments	*Torripsamments*	897.14	23.91
Total area			3752.73	100.00

Usage of the digital soil map in crop suitability classification:

Land suitability for some crops (i.e. wheat, melon, sunflower, olive, peach and alfalfa) was determined using MicroLeis software. The obtained data were linked to the attribute tables of the established database for defining the land suitability, Arc-GIS spatial analyst was used perform this task.

The soil characteristics such as soil depth, texture, calcium carbonate content, salinity, natural drainage and development of the soil profile were used in this system to determine the suitability class. Results of this determination are demonstrated in table (2). The suitability of 67 soil profiles representing the different soil types in the studied area was carried out; the results indicate that the olive, peach, wheat, melon and sunflower are the most suitable crops in the study area. Figs trees and barley are already found in the area with a good productivity. The soils in the area were classified to five groups (S2, S3, S4, S5 and N) according to their suitability classes and limiting factors. The map shows that the southern part of the study area is non suitable (N) for cultivation due to its very shallow depth and very high content of calcium carbonates as well as the domination of rock outcrops. The soils of piedmont and coastal plain have a good potentiality for cultivating by the selected crops, as they are classified S2 to S5. These classified soils are characterized by the following:

- Useful depth: 25 to 100 cm
- Soil texture: sandy to sandy clay loam
- Salinity: 0.25 to 31.5 dS/m
- $CaCO_3$: 10 to 57.1%
- Natural drainage: poor to excessively
- Stoniness: 0.2 to 25%
- Development of the soil profiles: incipient

The limiting factors in the soils of the piedmont and coastal plain are salinity, soil depth and texture. These factors decrease the suitability class to S2, S3, and S4 and sometimes to S5. The classes of S2, S3 are found mainly in the coastal plain where the classes of S4, S5 are exhibited in the soils of the piedmont.

In general, the investigated area could be cultivated by wheat, olive and peach with a suitability class (S2), however melon, sunflower and citrus with suitability classes S3, S4 and S5.

The barren lands are covered with gravels, stones, boulders and few patches of natural vegetation (small shrubs). These patterns of land cover are found mainly in the plateaus and the high parts of the piedmont.

Table (2): ***Limitation factors and land suitability classes of the studied soil profiles***

Profile no.	Limiting factors	Suitable crops	Class
1	Useful depth, Texture, Drainage	Wheat	3, 4
2	Useful depth, Texture, Salinity	Wheat	3, 4
3	Texture, Carbonate %	Olive, Peach,	2
4	Useful depth, Texture, Drainage	Non	5
5	Useful depth, Drainage	Wheat	3, 4
6	Useful depth, Texture	Olive, Wheat, Melon, Peach	2, 3
7	Texture	Olive, Wheat, Melon, Peach	2, 3
8	Useful depth, Texture	Non	5
9	Useful depth, Texture, Drainage	Non	5
10	Useful depth	Wheat	3, 4
11	Texture	Olive, Peach, Alfalfa, Melon, Wheat	2, 3
12	Useful depth	Wheat	3, 4
13	Texture, Carbonate %	Olive, Peach, Wheat, Melon	2, 3
14	Texture, Carbonate %	Olive, Peach, Wheat, Melon	2, 3
15	Texture	Olive, Peach, Wheat, Melon, Alfalfa, Sunflower	2
16	Non	Olive, Peach, Wheat, Melon, Alfalfa, Sunflower	2
17	Carbonate %	Olive, Peach, Wheat, Melon, Alfalfa, Sunflower	2, 3
18	Useful depth, Texture, Carbonate%	Olive, Peach, Wheat, Melon	3
19	Texture	Olive, Peach	4
20	Salinity, Useful depth,	Non	5

	Drainage		
21	Texture, Salinity	Olive, Peach, Wheat, Melon, Alfalfa, Sunflower	3
22	Non	Olive, Peach, Wheat, Melon, Alfalfa, Sunflower	2
23	Texture	Olive, Peach, Wheat, Melon, Alfalfa, Sunflower	2, 3
24	Texture	Olive, Peach, Wheat, Melon, Alfalfa, Sunflower	2, 3
25	Non	Olive, Peach, Wheat, Melon, Alfalfa, Sunflower	2
26	Texture	Olive, Peach	3
27	Carbonate %	Olive, Peach, Wheat, Melon,	2, 3
28	Non	Olive, Peach, Wheat, Melon, Alfalfa, Sunflower	2
29	Non	Olive, Peach, Wheat, Melon, Alfalfa, Sunflower	2
30	Texture, Carbonate %	Olive, Peach, Wheat, Melon	2, 3
31	Texture	Olive, Peach	3
32	Useful depth, Texture, Carbonate%	Olive, Peach, Wheat, Melon	3, 4
33	Carbonate %	Olive, Peach, Wheat, Melon,	2
34	Texture, Carbonate %	Olive, Peach, Wheat, Melon	3, 4
35	Useful depth, Texture, Salinity	Non	5
36	Useful depth	Olive, Peach, Wheat, Melon	2, 3
37	Texture	Olive, Peach, Wheat,	2, 3

		Melon, Alfalfa, Sunflower	
38	Texture, Carbonate %	Olive, Peach, Wheat, Melon	2, 3
39	Useful depth, Drainage, Carbonate%	Non	5
40	Useful depth, Carbonate%, Salinity	Wheat, Melon, Sunflower	2, 3
41	Texture	Olive, Peach, Wheat, Melon, Alfalfa, Sunflower	2, 3
42	Useful depth, Carbonate%, Salinity	Wheat, Melon, Sunflower	2, 3
43	Texture	Olive, Peach, Wheat, Melon, Alfalfa, Sunflower	2, 3
44	Useful depth, Texture, Drainage	Non	5
45	Useful depth, Carbonate%, Salinity	Wheat, Melon, Sunflower	2, 3
46	Useful depth, Texture, Drainage	Non	5
47	Useful depth, Texture, Drainage	Non	5
48	Useful depth	Wheat	3
49	Useful depth, Drainage	Non	5
50	Useful depth, Texture, Drainage	Non	5
51	Texture	Olive, Peach, Wheat, Melon, Alfalfa, Sunflower	2, 3
52	Texture, Salinity	Olive, Peach, Wheat, Melon, Alfalfa, Sunflower	2, 3
53	Texture	Olive, Peach, Wheat, Melon, Alfalfa, Sunflower	2, 3
54	Useful depth, Texture, Carbonate%	Wheat, Melon, Sunflower	2, 3

55	Useful depth, Drainage	Non	5
56	Useful depth, Drainage	Non	5
57	Useful depth, Drainage	Non	5
58	Useful depth	Non	5
59	Carbonate%	Olive, Peach, Wheat, Melon, Alfalfa, Sunflower	2, 3
60	Carbonate%	Olive, Peach, Wheat, Melon, Alfalfa, Sunflower	3, 4
61	Carbonate%	Olive, Peach, Wheat, Melon, Alfalfa, Sunflower	3, 4
62	Useful depth	Olive, Peach, Wheat, Melon, Alfalfa, Sunflower	3, 4
63	Useful depth	Olive, Peach, Wheat, Melon, Alfalfa, Sunflower	3, 4
64	Useful depth, Drainage	Non	5
65	Useful depth, Drainage	Non	5
66	Useful depth, Drainage	Non	5
67	Carbonate%	Olive, Peach, Wheat and Melon	3, 4

CONCLUSIONS

It can be concluded that the digital mapping of land resources encouraged by the progress of Geographic Information System (GIS) and data provided by satellite images. Such approach may preserve in the investment spent in soil and other thematic mapping, as the digital maps are more granted compared with analogue ones. Updating and manipulating the digital thematic maps are accessible and economically effective. Usage of the digital maps and their attribute tables assist the decision support systems and may result in obtaining maps required for controlling sustainable development projects. The digital format of the soil map facilitate the linkage with the different software, this allow the integration of data for defining the optimum

land uses of the studied region. The obtained results from the established database recommend that the soils of alluvial fans and watershed basins are most suitable for olives, peach, wheat, beans, and sunflower cultivation.

REFERENCES

1. Abou-Shleel, S. M., Jalhoum, M. E., & Belal, A. (2020). Agro-ecological zones delineation based for agricultural development in Sinai Peninsula using geo-informatics techniques. Al-Azhar Journal of Agricultural Research, 45(1), 23-32.
2. Adam, N. R., & Gangopadhyay, A. (2012). *Database issues in geographic information systems* (Vol. 6). Springer Science & Business Media.
3. Khalifa, M. E., & Beshay, N. F. (2015). Soil classification and potentiality assessment for some rainfed areas at West of Matrouh, Northwestern Coast of Egypt. *Alexandria Science Exchange Journal*, *36*(OCTOBER-DECEMBER), 325-341.
4. Stumpf, F., Schmidt, K., Goebes, P., Behrens, T., Schönbrodt-Stitt, S., Wadoux, A.and Scholten, T. (2017). Uncertainty-guided sampling to improve digital soil maps. *Catena*, *153*, 30-38.
5. **CONOCO, (1989)**. "Stratigraphic Lexicon and Explanatory Notes to the Geographical Map of Egypt 1: 500,000" Editor: Maurice Harmina, Eberhard Klitzsch and Franz K. List, Conoco Inc., Cairo,
6. de Carvalho Junior, W., Lagacherie, P., da Silva Chagas, C., Calderano Filho, B., & Bhering, S. B. (2014). A regional-scale assessment of digital mapping of soil attributes in a tropical hillslope environment. *Geoderma*, *232*, 479-486.
7. Edeki, C., & Pandya, S. (2012). Comparative study of data mining and statistical learning techniques for prediction of cancer survivability. *Mediterranean journal of Social Sciences*, *3*(14), 49-49.
8. **Egyptian metrological Authority (1996)**. "Climatic Atlas of Egypt" Published., Arab republic of Egypt. Ministry of transport.
9. **FAO (1970)**. "United Arab Republic: Pre-investement survey of the northwestern coastal region" Comprehensive account of the project. Technical Report 1 ESE: SF/UAR 49: 109 P., 5 Maps.
10. **FAO (2006)**. "Guidelines for soil description" Fourth edition, FAO, Rome, ISBN 92-5-105521-1.
11. **Hammad, M.A., Haraga, A., El Shazly M., and Omar M. (1981)**. "Morphopedological studies of the soils of North Western Coast of Egypt" Egypt. J. soil sci. 21, No. 1 pp. 79-97, 1981.
12. **NARSS (2005)**. "Environmental Evaluation of Land Resources in the Northwestern Coast of Egypt, Using Space Data and Land Information Systems" Final report, National Authority for Remote Sensing and Space science (NARSS), Cairo, Egypt.
13. USDA, (2004).n"Soil Survey Laboratory Methods Manual" Soil Survey Investigation Report No. 42 Version 4.0 November 2004.

CALCULATION OF METHANE EMISSIONS FROM MUNICIPAL SOLID WASTE LANDFILL GERMOVA USING IPCC METHOD

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UDC: 628.312.5.033:547.211(497.115)

ABSTRACT

The paper presents an estimation of methane emission from deposited municipal solid waste in Germova landfill located in the Mitrovica Region for the years 2006–2019. Methane emission was calculated according to the methodology recommended by IPCC 2006, using default values. Within framework of the research, the following parameters were evaluated: population covered by the waste collection service in the region, amount of landfilled waste, landfill characteristics, and composition of landfilled waste and climate conditions of the region. Based on these parameters, the total amount of CH_4 emitted from the landfill during 2006–2019 was estimated at 19.3 Gg or 485 Gg CO_2 eq.

Keywords: waste, solid, municipal, methane, landfill, emission

INTRODUCTION

Increases of the urban population indicate to increasing amount of solid waste disposal. One of the major impacts of waste disposal is the emissions of greenhouse gases, mainly methane, to the atmosphere. These greenhouse gases are produced from biodegradation of waste under anaerobic conditions through microbial activities. Landfill gas emission from municipal solid waste landfills, plays a significant role causing global climate changes,

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because these waste disposal sites are considered as one of the most important anthropogenic sources of greenhouse gases, especially methane gas (IPCC, 2006). Landfills are ranking as the third-largest anthropogenic CH_4 source (Ritzkowski et al., 2007). Landfills are responsible of 11% of methane global anthropogenic emissions, ranging as the third largest source of anthropogenic methane in the world (EPA USA, 2017). CH_4 emissions from managed landfills accounted for 1.8% of total EU-15 GHG emissions in 2011. Between 1990 and 2011, CH_4 emissions from managed landfills declined by 47% in the EU-15. A main driving force of CH_4 emission reduction was the amount of biodegradable waste going to landfills which declined by 53% between 1990 and 2011 (Eurostat, 2014). Before 2000, most of the solid waste collected from urban areas in Kosovo was deposited in unmanaged landfills or waste dump sites. During the past decade, there was an improvement of waste disposal practice from open dumping and unmanaged landfills to sanitary managed landfills. This improvement of waste management increased the amount of waste disposed (Berisha & Dimiskovska, 2018). Currently, about 60% of the solid waste is disposed in sanitary landfills. (KEPA, 2015; KAS, 2017). The GHG emissions from waste management in Kosovo represent around 4% of the total GHG national emissions. Methane emissions from managed municipal solid waste landfills are major source of GHG emissions from the waste sector in Kosovo (KEPA, 2015; UNDP Kosovo, 2012). There are 6 municipal and regional waste landfills in the territory of Kosovo, which are considered as sources of methane emissions and with a potential risk and impact on air, waste, soil and public health (Veselaj et al., 2013).

MATERIAL AND METHODS

Characteristics of the Landfill

The sanitary landfill of Solid Waste Management for the Mitrovica Region is situated in Germova location. The landfill serves for depositing of waste collected from the municipalities: Mitrovica, Vushtrri, Skenderaj and Zvecan. Population covered by the waste collection service in the region represents 43.2%, (or 83089 inhabitants) of the population of the region (MLGA, 2017). Detailed information are presented in the Table 1.

The landfill was constructed in 2000, under the project funded by DANIDA (Danish International Development Agency). The waste filling process in the sanitary landfill started at the beginning of 2001, in a natural valley after implementation of a basic sealing with PE-foil. The total area of the landfill is about 7 ha. The waste landfilling area has a size of about 3.5 ha. Because the valley shape of the landfill, there is no uniform waste filling height in

different landfill zones. The maximum waste height is estimated with about 20 m. The waste landfilling process shall be continued up to the year 2025.

Table 1 - Number of population covered with waste service collection in the Mitrovica Region

Municipalities	Area of municipality km^2	Nr. of population	% of population covered by the waste collection service	Nr. of population covered by the waste collection service
Mitrovica	325	68400	60 %	41040
Skenderaj	374	51745	30 %	15524
Vushtrri	345	64578	36 %	23248
Zubin Potok	334	6554	50%	3277
Total	1378	191277	43.5 %	83089

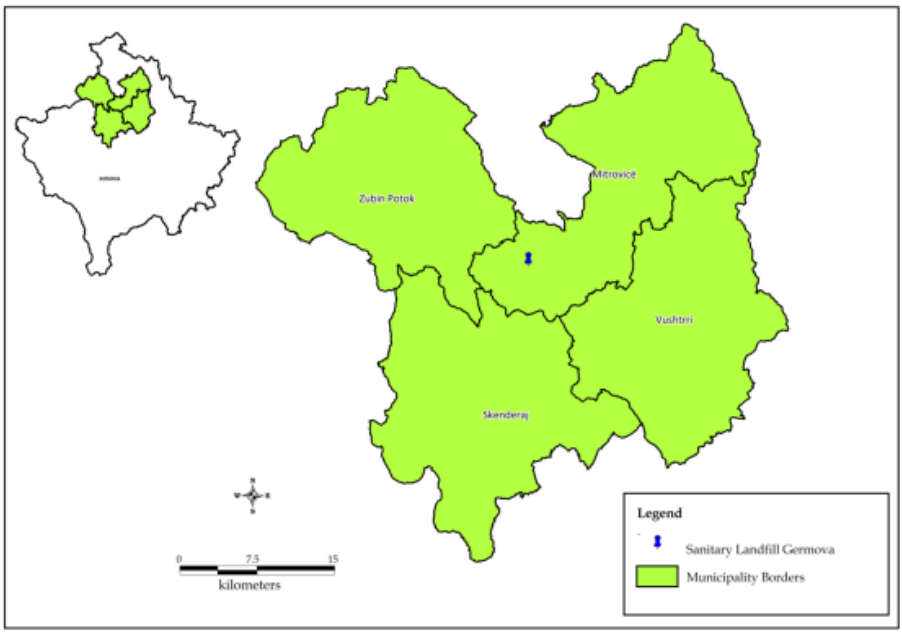

Figure 11 – Map of the Mitrovica Region and its position within Kosovo

There is no adequate equipment for active degassing of the landfill. The characteristics of the sanitary landfill in Germova are presented in table 2.

Table 21 - Characteristics of Sanitary landfill in Germovo – (KEPA, 2008)

Starting year of operation	2001
Type of landfill	Managed semi-aerobic
Status of landfill	Current use
Area of landfill	7 ha
Waste deposition area	3.5 ha
Maximal height of waste	20 m
Total deposited waste until 2016 tons	774,456
Waste deposition is planned up to the year	2025

Climate Conditions Prevailing in the Mitrovica Region

Numerous physical conditions and interactions influence methane generation from landfills. Refuse composition, temperature, moisture content, topography, pressure, pH and microbial interactions are some of the factors considered influential for methane generation and emission levels (EPA AU, 2001). The ambient temperature and rainfall exhibited, has a strong correlations with landfilled gas components (Lie Yang et al., 2015). The landfill will increase in temperature as bacterial decomposition occurs, with temperatures ranging between 21^0C and 43^0C on average during phases of decomposition (Castillo, 2006).

Germova landfill is located in Mitrovica region, which is characterized by a prevailing continental climate with 570 mm/yr of rainfall, and with yearly average of air temperature about 10.5 Celsius (KHMI, 2018). Climate conditions for the Mitrovica Region are based on the historical data for this region and are shown in the figure 2.

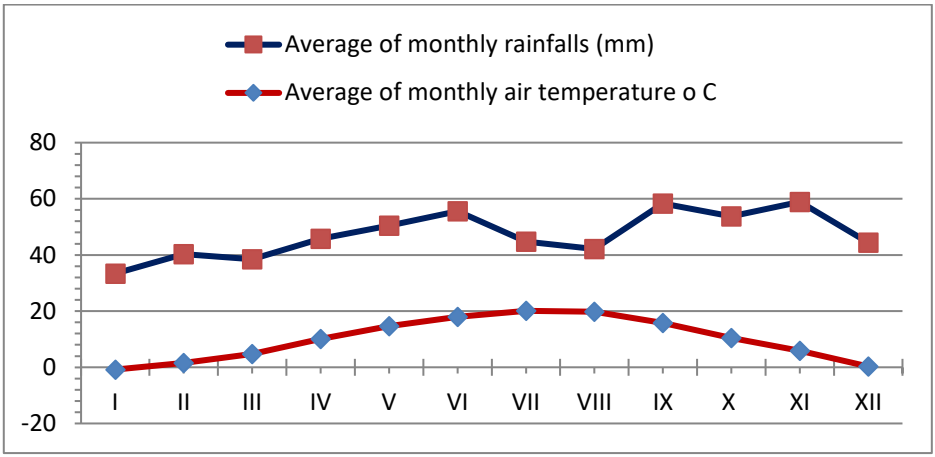

Figure 2 - Climate conditions in the Mitrovica region – (KHMI, 2018)

Quantification of CH_4 emission

Calculation of CH_4 emission from the landfill in Germovo was based on data on the landfilled waste for the interval 2006–2019. The estimate of CH_4 emission from the landfill has been carried out by means of empirical calculation according to the IPCC recommendations (IPCC, 2006). The 2006 IPCC Waste Model allows calculation with limited data on waste disposal to produce greenhouse gas emissions data over a time frame, using the first order decay model. This method will improve estimates of methane emissions from solid waste disposal (Castilo, 2006). Implementation of specific obligations related to monitoring and reporting of GHG emissions and ensuring public information is a national obligation (MESP, 2016).

The IPCC default method for estimation of methane emission from waste disposal sites is based on the following equation:
Methane emissions = (MSWT*MSWF*MCF*DOC*DOCF *F*16/12-R)*(1-OX)
Where:
MSWT = Total amount of generated waste (Gg/year)
MSWF = Fraction of disposed waste
MCF = Correction factor of waste fraction that generates methane gas for the sanitary landfill.
DOC = Fraction of biodegradable organic carbon
DOCF = Fraction of biodegradable organic carbon that is readily available for degradation
F = Fraction of methane in biogas.
OX = Fraction of methane gas that is oxidized to carbon dioxide.

To perform the emission calculations over the years 2006–2019, annual data on waste disposal and composition of waste deposited into the sanitary landfills, were collected from the Kosovo Environmental Protection Agency and, Statistical Agency of Kosovo and municipalities of the region. Calculations of the emissions were based on the IPCC 2006 model spreadsheet, as described in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories. The specific parameters and values according to IPCC method applied for estimation of CH_4 emissions from Germovo landfill are presented in table 3.

Table 3: Parameters according to IPCC 2006 default value used for the sanitary landfill in Germovo (IPCC, 2006)

Parameters		**Value**
DOC (Degradable organic carbon) (weight fraction, wet basis) Waste by composition	Food waste	0.15
	Garden	0.2
	Paper	0.4
	Wood and straw	0.43
	Textiles	0.24
	Disposable nappies	0.24
DOCf (fraction of DOC dissimilated)		0.5
Methane generation rate constant (k) ($years^{-1}$)	Food waste	0.185
	Garden	0.1
	Paper	0.06
	Wood and straw	0.03
	Textiles	0.06
	Disposable nappies	0.1
Delay time (months)		6
Fraction of methane (F) in developed gas		0.5
Conversion factor, C to CH_4		1.33
Oxidation factor (OX)		0
Methane Correction Factor (MCF) for managed semi-anaerobic landfills		0.5

RESULTS AND DISCUSSION

Disposal of wastes

The yearly amount of deposited waste in the sanitary landfill in the sanitary landfill Germova amounted about 53,729 tons in 2019. About 774,456 tons of waste was deposited in the period 2001-2019 (KEPA, 2019). Detailed information on the waste disposals to the sanitary landfill in Germova for the time period 2001-2019 is presented in table 4.

Table 4 - Waste disposals in the sanitary landfill in Germovo

Year	Waste disposal per year/tons	Disposed waste from year to year/tons
2006	34,778	194,142
2007	35,822	229,964
2008	36,986	266,950
2009	38,003	304,953
2010	39,143	344,096
2011	40,317	384,413
2012	41,527	425,940
2013	42,773	468,713
2014	41,833	510,546
2015	39,546	550,092
2016	43,863	593,955
2017	64,663	658,618
2018	62,109	720,727
2019	53,729	774,456

Waste Composition in Mitrovica Region

The microbial breakdown of food waste is a major factor in production of GHG's in landfills (EC, 2009). It has significant relationship with CH_4 emissions from the perspective of generation process. The degradable organic carbon is the key to the generation of pollutants and CH_4 (CAI Bo-Feng et. al., 2014). Methane is produced by the bacterial decomposition of organic matter within landfills; therefore the amount of organic waste within a landfill will dictate the amount of gas that is produced, where higher concentrations of organic matter will yield higher concentrations of methane (Kumar et al., 2004).

According to analysis of waste composition performed for the municipalities of Mitrovica region, it is characterized by a higher content of organic waste fractions. The main fractions of waste composition are food waste accounting for 38 % and paper and cardboard accounting for 13% (MESP, 2018; Riinvest Institute, 2016). Solid waste composition referring to the Mitrovica region is presented in figure 3.

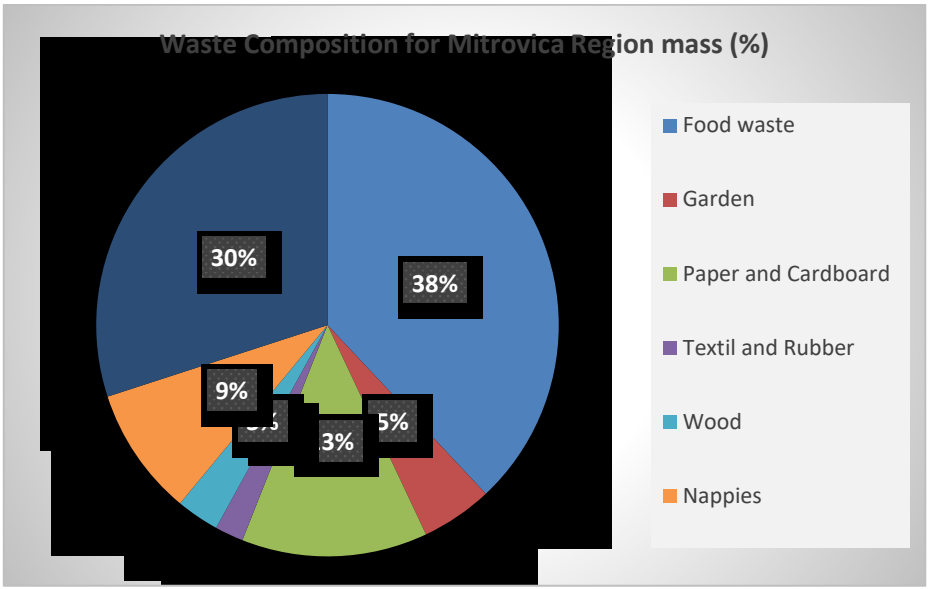

Figure 3 2- Waste composition for the Mitrovica Region (mass %)

Calculation of CH_4 emission

Calculations of the CH_4 emissions from the sanitary landfill in Germovo, during 2006–2019 are presented in figure 4. The total mass of CH_4 generated in the landfill during 2006–2019 amounted to 19.3 Gg, or 485 Gg CO_2 equivalents (eq).

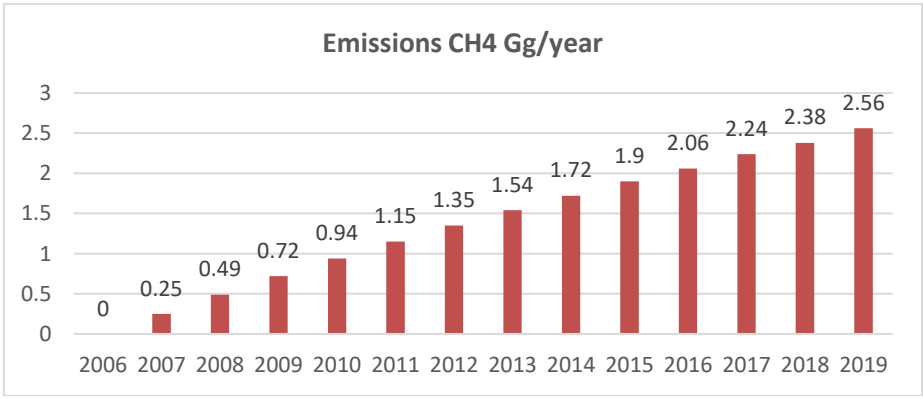

Figure 43 - CH_4 emissions from the sanitary landfill Germova 2006-2019 Gg/yr

There are two life stages in a landfill; its operating stage, where municipal solid waste (MSW) is being disposed and its closed stage, where storage capacity is reached. Operating landfills emits more CH_4 than closed landfills

since the major part of degradation occurs in the first few years following disposal with decreasing emission rates with time after closure (Furie et al., 2004). According to determination of the phase of development of the landfill, results shows that landfill studied is in the beginning of phase IV of decomposition of the municipal solid waste. The phase IV of the landfill is known as the methane fermentation phase or long term stable methane generating phase. Duration range of this phase is from 5-50 years (Pohland et al., 1986; EPA IR, 2011).

CONCLUSIONS

GHG accounting and reporting in waste landfilling is of crucial importance as landfill is still the most common waste disposal method world-wide. The CH_4 emissions from sanitary landfill Germovo have been estimated individually according to specific information of the region (waste composition, climate conditions, landfills characteristics, amount of waste disposal, and other specific parameters) influencing the emission factors for landfills in accordance with IPCC 2006 are used instead of the most of the other studies, which was based only in the data on national level. The results of the study are important information which can be used for the development of country specific emissions factor for estimation of the methane emissions from waste disposal category. The mitigation of GHG emissions from waste disposal in the Mitrovica region must be addressed in the context of integrated waste management and implementation of standards that require or encourage landfill CH_4 recovery and a reduction in the quantity of biodegradable waste that is landfilled.

REFERENCES

1. Annual Report State on the Environment 2016, Kosovo Environmental Protection Agency.
2. Cai, B.F., Liu J.G., Gao, Q. X., Nie, X. Q., Cao, D., Liu, L. C., Zhou, Y., Zhang. Z. S. (2014). *Estimation of Methane Emissions from Municipal Solid Waste Landfills in China Based on Point Emission Sources.* Advances in Climate Change Research 5(2): 81-91, 2014.
3. Castillo, E. C. (2006). Study Of The Operational Conditions for Anaerobic Digestion of Urban Solid Wastes. Waste Management, 26, 546-556.

4. EC. (2009). National Inventory Report: Greenhouse Gas Sources and Sinks in Canada 1990-2007. Ottowa, Ontario: Enviornment Canada.
5. Emissions of Green House Gas in Kosovo 2008-2013. Kosovo Environmental Protection Agency 2015
6. EPA Ireland (2011); Management of Low Levels of Landfill Gas; Prepared by Golder Associates Ireland Limited on behalf of the Environmental Protection Agency (Office of Environmental Enforcement), ISBN: 978-1-84095-394-7
7. Eurostat (2014). Greenhouse gas emissions from waste disposal [Report], (2014).
8. Fourie A.B., Morris J.W.F., (2004). Measure gas emissions from four landfills in South Africa and some implications for landfill design and methane recovery in semiarid climates, Waste Management and Research, 22, 440–453.
9. Global Anthropogenic Non-CO2 Greenhouse Gas Emissions: 1990 – 2030, Environmental Protection Agency USA.
10. Guidelines for National Greenhouse Gas Inventories. National Greenhouse Gas Inventories Programme. 2006. IPCC. (Annex 3).
11. Historical data on climate conditions for Kosovo (Annual Meteorological Year Book 1950-2000, Kosovo Hydro-meteorological Institute.
12. Intergovernmental Panel on Climate Change (IPCC). 2007. Fourth Assessment Report: Climate Change 2007 (AR4). Geneva: IPCC.
13. Kosovo Greenhouse Gas Emissions 2008 – 2009. UNDP Kosovo, 2012.
14. Kumar, S., A.N. Mondal, S.A. Gaikwad, S. Devotta,R.N. Singh. 2004. Qualitative assessment of methane emission inventory from municipal solid waste disposal sites: A case study. *Atmos. Environ*. 38:4921–4929.
15. Landfills in Kosovo-Landfill gas prognosis and roughly cost estimation of gas utilization, SEF-Energietechnik GmbH & GIZ, 2015.
16. Lie Yang, Zhulei Chen, Xiong Zhang, Yanyan Liu & Ying Xie (2015) Comparison study of landfill gas emissions from subtropical landfill with various phases: A case study in Wuhan, China, Journal of the Air & Waste Management Association, 65:8, 980-986.
17. Methane Generation from Victorian Landfills, Publication 755 March 2001.
18. Municipal Solid Waste Survey in Kosovo, Ministry of Environment and Spatial Planning (2018).
19. Municipal Waste Management Plan 2016-2020, Vushtrri Municipality.
20. Municipal Waste Survey 2016. Kosovo Agency of Statistics, 2017. KAS
21. Municipality Performances Report for 2016 (2017) - Ministry of Local Government Administration.

22. Pohland, F. G. and Harper, S. R. (1986), "Critical Review and Summary of Leachate and Gas Production From Landfills", EPA/600/2-86/073, Cincinnati, OH, U.S.A.: U.S. Environmental Protection Agency.
23. Report on the Kosovo's Legal Framework in the Climate Change Sector vis-a-vis the Requirements of the EU Climate Legislation 2016, *Ministry of Environment and Spatial Planning.*
24. Ritzkowski, M. and Stegmann, R. (2007). Controlling Greenhouse Gas Emissions through Landfill In Situ Aeration. International Journal of Greenhouse Gas Control [Journal].
25. State of the Waste and Chemicals 2014, Kosovo Environmental Protection Agency.
26. State of the Waste Report 2008, Kosovo Environmental Protection Agency.
27. Veselaj, T., Hyseni, M., Berisha, A., Gashi, P., Morina, R., Morina, I., Cornel, F.G. (2013). Veselaj T, Berisha A, et al, (2013); Environmental threatened places - "hotspots" in Kosovo, International Society for Environmental Epidemiology (ISEE), Environment and Health Conference, Basel Switzerland, 2013.
28. Waste Management in 16 Municipalities, Opportunities for Inter-Municipal Corporation. Riinvest Institute 2016.

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THE ROLE OF CARTOGRAPHY IN MEDICAL RESEARCH

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ABSTRACT

The article presents a new direction of earth and human sciences - medical mapping. The modern concept of medical mapping and its benefits for population health are discussed. The contemporary Geographic Information System (GIS) made generating of medical maps relatively easy. In this study, multiple medical maps were compiled (only two are presented here) based on databases for two neurological diseases - hereditary peripheral neuropathies and epilepsy in GIS environments. The number of patients included in the database is updated regularly, which requires a technology that makes it possible to easily compile maps that represent constantly changing data. For this reason GIS technology is one of the most promising tool in epidemiological researches.

Key words: medical maps, neurological diseases

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INTRODUCTION

Population health is one of the most sensitive topics, both for individual countries and regions, and for the world in general. Improving a person's health and increasing life expectancy leads to a longer and more productive working life, which affects postively the economic development of each country.

Various institutions at national, regional and global level collect data on the health status of the population and its trends of change. These data allow different indicators to be calculated and to provide additional information on demographic processes, morbidity, risk factors, disability, etc.

All this led to the emergence of the link between cartography and medicine since mid 18th century. The first and most famous thematic map is Snow's

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map in the field of medical mapping. Later, medical mapping became a new section of cartography. An example of a contemporary interactive map representing a popular disease these days is available online (CSSE at Johns Hopkins University, 2020) and is dynamically updated in the same time as the database is updated. Nowadays, special requirements are imposed on databases. The INSPIRE Spatial Data Specification document defines the exact requirements for reference and thematic data that is included in a thematic database on human health and safety (European Commission, 2007). All thematic maps in the digital environment are compiled according to these requirments.

The purpose of this study is to present the implementation of GIS in population health by developing medico-geographical maps in epidemiological studies for two neurological diseases – hereditary peripheral neuropathies (Fig.1) and epilepsy (Fig.2). Hereditary peripheral neuropathies are a group of neurological diseases affecting the peripheral nerves due to various genetic mutations. The disease is characterized by progressive muscle weakness and sensory deficiency. Epilepsy is a disorder of the central nervous system and manifests with recurrent epileptic seizures, caused by pathological neuronal excitability.

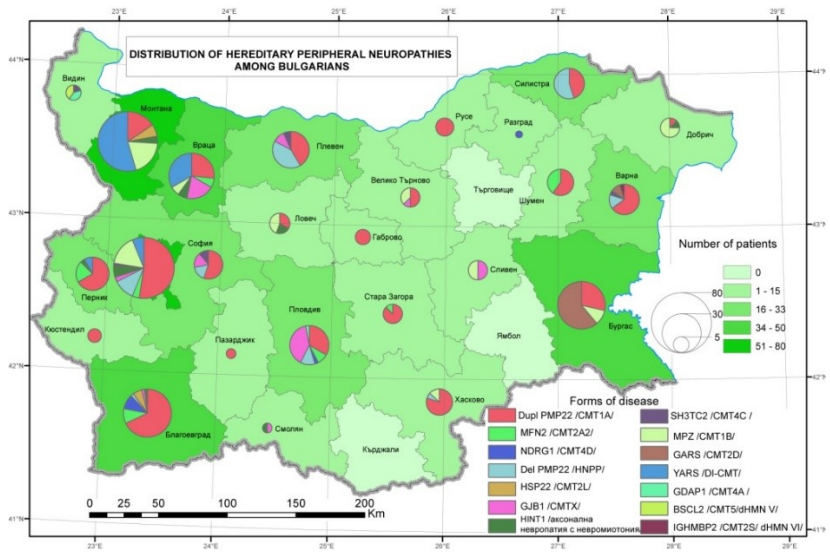

Fig.2.Distribution of genetic forms of hereditary peripheral neuropathies among the Bulgarian ethnic community

METHODS OF STUDY

Methods of gathering information. The information on which the maps are based is based on patients registries from the Expert Centre for Hereditary Neurological and Metabolic Disorders in University Hospital ”Alexandrovska”, and on registries of Regional Health Insuarance Fund in Blagoevgrad. They contain demographic, genetic and clinical data.

Methods for data analysis and cartographic methods. A number of ArcGIS statistical tools were used for statistical data processing. Geographic Information Systems (GIS), the most popular and modern tool for collecting and managing huge and dynamically changing volumes of information, was used to create a Geographic database (GDB). It is structured in an ArcGIS environment.

RESULTS

Analysis of the collected data on patients with hereditary peripheral neuropathies, identify 16 different genetic forms, as well as ethnic differences in terms of the most common neuropathies among the three ethnic (Bulgarians, Roma, Turks) groups in Bulgaria (Kastreva, 2018). For this reason four different maps were compiled, one for each ethnic group and one map for the entire tested population. The distribution of the different genetic forms varies in the different administrative districts of the country, which is easily detetctable on the medico-geographic maps. The number of affected in each region is represented by color saturation, and the number of individuals with certain genetic forms is presented by sectors of pie charts. The size of the circle diagrams also corresponds to the total number of affected individuals.

The second map presents the distribution of epilepsy in Blagoevgrad district for a certain time period. In the map is implemented not only the number of cases in the different municipalities of the district, but also a distribution by gender. Here, again color saturation, as well as the size of the circle diagram, are used to present the number of individuals with epilepsy in each region and the sectors of the pie chart give information on the number of the affected males and females.

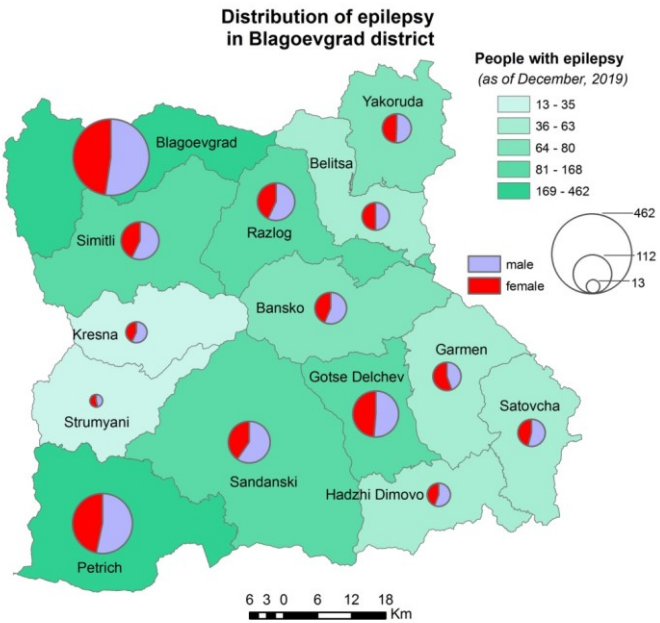

Fig. 2 Epilepsy prevalence based on the data from Regional Health Insurance Fund

CONCLUSIONS

Medico-geographical maps give interpretation and visualization of collected data, which allows the information to be analyzed from a different point of view and to be presented to non-medical audiance for better understaning. Maps also can give answers to many questions regarding population health and can be used to detect easily more severily affected areas from a certain disease and to distribute health care adeuately.

REFERENCES

1. Kastreva, K., 2018. Development of a clinical database for phenotyping of hereditary neurological diseases. Doctoral dissertation. Medical University Sofia. Available at: <https://ras.nacid.bg/api/reg/FilesStorage?key=0325f27d-79cd-4d00-bf43-672541bbd512&mimeType=application/pdf&fileName=Reviewed_disertacia-04-2018.pdf&dbId=1> and

https://ras.nacid.bg/api/reg/FilesStorage?key=6d3883d6-0178-4d8b-ad66-bf11251f18a0&mimeType=application/pdf&fileName=avtoreferat_final.pdf&dbId=1 [accessed 10.04.2020]

2. Center for Systems Science and Engineering (CSSE) at Johns Hopkins University. 2020. Coronavirus COVID-19 (2019-nCoV) at <https://gisanddata.maps.arcgis.com/apps/opsdashboard/index.html?fbclid=IwAR1XpnFwKiWdp6BJhbRrkwXywi9AA5g7Xgu0FSGZ58NqLB1kRDq9qZX6d1Y#/bda7594740fd40299423467b48e9ecf6 >[Accessed 16 April 2020]

3. European Commission. 2007. Data Specifications | INSPIRE at < https://inspire.ec.europa.eu/data-specifications/2892> articles/i/english-embroidery-introduction/> [Accessed 16 April 2020]

LIMESTONE, CLAY RESERVES AND THEIR UTILIZATION IN THE FIELD OF CONSTRUCTION

Hazir ÇADRAKU[1] and Visar KRELANI[2]

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ABSTRACT

Limestones and clays are non-metallic minerals, are classified in the sub-group of the non-renewable natural resources and are of significant importance particularly in the field of construction. As far as constructors are concerned limestone rocks and clays continue to be categorized as the main materials, which are at a large scale used in low and high construction. These construction materials are primarily used in wall molding, filling, production of various fractions for the preparation of concrete, production of various types of facades, adhesives, production of bricks, blocks, tiles and other products. The underlying purpose of thispaper is to carry out a subtle analysis of the reserves, utilization and some of the main features of limestone and clay in the Republic of Kosovo. Limestones and clays are industrial minerals (non-metallic minerals) which bear peculiar characteristics such as; textural, structural, physico-mechanical, geological etc. The territory of Kosovo is relatively rich in limestone and clay reserves. Estimated geological reserves in 1978 were 128 million ("M"-million [m^3] limestone and 15 "M" [ton] clays, while in 2014 were 361 ("M") [m^3] limestone and 27 "M" [ton] clays. According to the physico-mechanical properties limestone belongs to the type of moderately hard and very hard rocks. They have specific average weights of 2.71 [g/cm^3], compressive strength of a water-saturated shaft ranging from 107.3 to 152 MPa, CaO, MgO and SiO_2 contents of 54.06%, 0.97% and 1.28%. The mineral limestone contituent is mainly made of calcite which varies from 86.04 % to 97.6 %.

Key words: Kosovo, rocks, limestone, clay, construction, construction permission.

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INTRODUCTION

Limestone is a rock that originally formed under the ocean. It is made of the bones and shells of tiny sea creatures that died millions of years ago. Clay is a sticky, poor-draining soil. When fired in a kiln it becomes extremely hard. Bricks, tiles and pots are made this way, as well as ceramics-from fine porcelain to sewer pipes. Construction has always been considered as one of the most noteworthy human activities. During the last 16 years in Kosovo, the construction sector has been subject to a rapid grown at a faster pace compared to other sectors of the economy, and has fulfilled the increasingly high demands of the population for more housing, road infrastructure etc. Consequently, this has led to an increasing trend in the utilization of limestone and clay. In 2011 the urban population was estimated to approximately 38% (versus 32.5% in 1981 and 9.7% in 1948), while the rural population was 61.9%. Along with the growth of urban population, the area of settlements has expanded, so from 2002 to 2012 it is assessed that the area of settlements has increased by about 8000 ha *(KEPA, 2015)*. In the country, limestone and clay rocks are mainly used as natural raw materials for construction because they have good physico-mechanical properties and durability. Moreover they are extracted and processed at a lower cost than other rocks. In addition, it is worth emphasizing that they are characterized by a diversity, both in quantity and quality and comprise a priceless asset regarding country's economic development. Despite that, limestones have a wide spatial distribution throughout the territory of Kosovo *(Fig. 1)* and cover 13.1% of the territory *(Ahmetaj I., 1981).* They mainly build the mountain massifs on the west side (Mokna, Bjeshket e Nemuna, Pashtriku, Koritniku, etc.), in other areas of the country they appear in the form of mountain greens with more limited spread (Shkoza, Gllama, Baja etc.). From a techtonic point of view, limestones that are located in the western part of the country, pertaining to the region of Mirdita, which in the territory of Kosovo includes Pashtrik, Koritnik and Shkoza mountains *(Andelkovic J, 1976)*. The geological reserves of limestone in 1978 were 128 million [m^3] *(Jakupi A., 1978)*, while in 2015 these reserves are 361 [m^3] *(ICMM, 2015)*, whereas the geological reserves of clay in 1978 were 15 thousand [ton] *(Jakupi A.,1978)*. In 2015 these reserves are 22 thousand [tonnes] *(ICMM, 2015)*. They are unmixed, bound rock bottom rocks dominated by clay minerals *(Shkupi N. D., 1984)*. The most important clay sources in Kosovo are found in: Podujevo, Zveçan, Skenderaj, Peja, Gjakova, Klina, Rahovec, Prizren, Hani i Elezit, Ferizaj, Prishtina and Kamenica.

STUDY AREA

The Republic of Kosovo is located in Southeast Europe (Western Balkan Country), in the center of the Balkan Peninsula *(Fig.1)*, between the coordinates 41°50'58" to 43°15'42" north latitude, 20°01'02" to 21°48'02"and the eastern geographic length *(PHK, 2010-2020+)*. It has an area of 10.905,25 km2, with 1469 settlements with a population of 1.782.115 inhabitant *(ask.rks-gov.net, 2020)*. The population density is 163 inhabitants per km^2, whereas the average age is approximately 25 years. The climate is continental medium *(Pllana, 2015)*, average annual temperature 10ºC (min., -27ºC and max., 39ºC), average annual precipitation in the eastern part on average fall over the year 600 mm, while in the western part above 700 mm *(KEPA, 2015)*. As far asthe morphological point of view is concerned, the peripheral part is interspersed with mountainous massifs, whereas the plain part consists of: Dukagjini basin and Kosovo plain. Minimum altitude of 252 m (Drini i Bardhe-Vermica), at maximum 2565 m (Gjeravica peak).

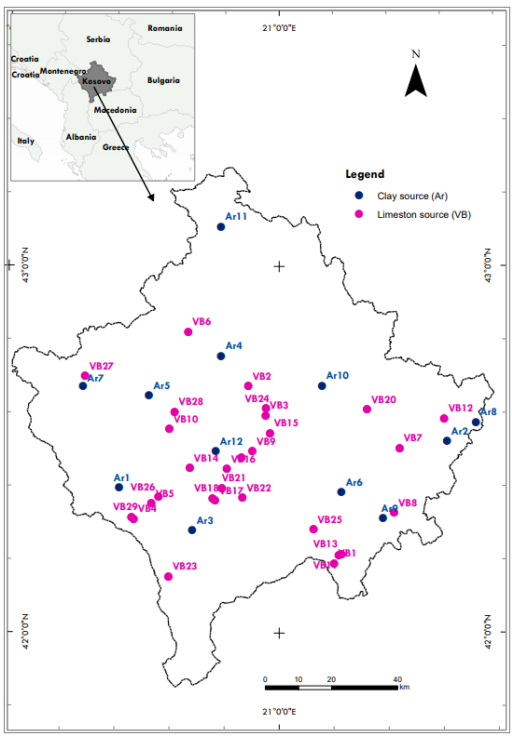


Fig.1. The study area

Geology-Geological construction is quite complex and involves rocks of all geological ages from the Paleozoic to the Quaternary *(Elezaj Z., Kodra A., 2008)*. Due to the fact it is necessary to carry out a fully-fledged analysis of rocks pertaining to all geological ages from the Paleozoic to the Quaternary participate. Carbonate rocks (limestone, dolomite, marbles, etc.). The massive Paleozoic limestones are mainly located at low altitudes. They have the highest prevalence in the lidar (Drenica Mountains). Mesozoic limestones (Triassic, Cretaceous) are far more widespread in the western part and partially in the central part. They are comprised of massive limestone blocks. The Triassic limestones are widespread in the mountains; Mokna, Sharri, in the Central Mountains, in the Koritnik Mountains. The Cretaceous limestones are spread in the mountains of Pashtrik, Drenica and Caraleva.

METHODOLOGY AND MATERIALS

There has been carried out a development strategy, which represents a systematic work supported by field observations as well as utilizing analogous experience and practices. The method of analysis is mainly quantitative, utilizing accurate qualitative data. The type of research for this paper enters the research group relying on the collection of institutional and scientific materials *(Jakupi A., 2005)*. To achieve the purpose of this research it was necessary to browse an extensive literature on the geology of Kosovo. The first phase of the work was the collection of archival materials, written and published by researchers and public institutions related to the management of natural resources, namely carbonate rocks and clays. The second phase was related to the selection, processing, analysis and interpretation of data and the third phase was the writing of the paper. Indeed, there has been depicted a wide range of archival documents, strategic documents, development plans, normative acts, reports, reports, as well as relevant data produced by state and academic institutions, professions and designers in the field of geology and mining. The materials used in this research work have been; topographic maps at a scale of 1:25000 *(https://www.topografskakarta.com/)*, geological maps at a scale of 1:100 000 *(Vojnogeografski institut. 1984)* and 1: 200 000 (*ICMM, 2006)*, clarifiers of geological maps at a scale of 1:100 000. Official reports published by the Independent Commission for Mines and Minerals, Elaborate for the calculation of geological reserves for limestone and clays and books published in connection with the mineral resources of Kosovo as

referred to in this paper. For technical work the Excel program was used for the construction of tables and graphs, while for the georeferencing, digitalization and preparation of the source map for limestone and clay the ArcMap program was used.10.1.

RESULTS AND DISSCUSSION

In the Republic of Kosovo, limestone clays and clays are widely used in the field of construction, owing to the fact that they are spread throughout its structural-facial areas. to the newer ones.In terms of mineralogical composition the limestones are mainly composed of calcite ranging from 86.04% to 97.6%.They are white, gray, gray to dark, often with yellowish hues and reddish veins. Among others, it's worth pointing out that they consist of pure, compact, good quality limestone, and also meet medium dolomitized breccia limestones that have undergone this process. In some sources metamorphosed limestones of varying degrees, turning to marble. Limestones generally show good geological-engineering properties during opening and exploitation, in which exploitation troughs of 15 m to 20 m can be formed *(Bytyqi B, 2010)*. The VB20 source limestones have shown low to moderate metamorphism rates giving the limestone a recrystallized crystallocrystalline appearance with shell fractures. The physico-mechanical properties of this rock are of satisfactory value for its use as a cornerstone; ballast for all layers of road; saturation; substrates, stabilizers and coatings for asphaltbetone *(Konomi N & Mesh A, 2006)*. Limestone at the source VB22 is dolomitized marble limestone characterized by good physico-mechanical properties *(Civil Engeniering Institute "Macedonia" Skopje, 2010)*. The source limestone VB23 is reddishand represents biomycritic facies, from fossils to rudistite found, the size of calcite crystals is from 0.5 to 1 mm *(Qorri N, 2005*). At source VB 17-18 are silicified, massive textured silica limestone, the main mass (over 95%) being carbonate *(Konomi N & Mesh A, 2010)*. During the period 2005-2015, 29 "M" [m^3] of limestone were exploited, with an average amount of 2,664,417.12 "M" [m^3] per year or 8% of the total limestone reserves known so far, while 859,363.85 tons of clay were exploited, or only 3.2% of the total amount of geological reserves known so far.
Table 1 dhe 2., shows the geological reserves of limestone and clay in some of the most popular sources, while figure 3 and 4., shows the progress of limestone and clay use in the period (2005-2015).

Table.1. Reserves of limestone

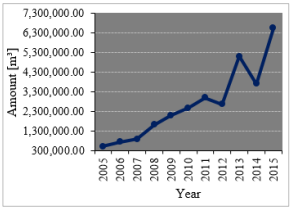
Table.2. Reserves of clay

ID	Reserves [m³]	ID	Reserves [m³]	ID	Reserves [m³]	ID	Reserves [m³]
VB1	10.734.000	VB15	1.828.360	VB8	735.000	VB22	218.169
VB2	50.386.000	VB16	1.127.057	VB9	4.028.399	VB23	188.854
VB3	15.411.000	VB17	1.200.348	VB10	1.588.000	VB24	1.738.098
VB4	12.000.000	VB18	548.677	VB11	517.159	VB25	4.554.108
VB5	15.376.000	VB19	1.759.892	VB12	104.399	VB26	754.581
VB6	4.446.000	VB20	689.360	VB13	6.711.207	VB27	375.734
VB7	4.033.000	VB21	853.044	VB14	3.822.648	VB28	3.000.000
						VB29	14.103.903

*VB-for Limeston source

ID	Reserves [m³]	ID	Reserves [m³]
Ar1	3.856.905	Ar7	1.000.000
Ar2	2.543.551	Ar8	1.000.000
Ar3	2.598.072	Ar9	10.000.000
Ar4	3.000.000	Ar10	500.000
Ar5	2.242.353	Ar11	600.000
Ar6	2.500.000	Ar12	250.000

*Ar-for Clay source



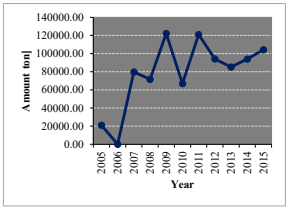


Fig.3. The scale of utilizing limestone ***Fig.4.*** The scale of utilizing clay

The physical-mechanical components of limestone in Kosovo, are at a large scale comprisedof good mechanical properties which are shown below; specific weight fluctuates in the range of 2.67 g/cm³ to 2.75 g/cm³, natural weight volume fluctuates from 2.65 g/cm³ to 2.72 g/cm³, dry volume weight fluctuates from 2.62 g/cm³ to 2.68 g/cm³. The degree of porosity varies from 0.01% to 2.2%. Meanwhile, water absorption ranges from 0.052% to 0.51%. The similarity ranges from 0.97 to 0.99. The resistance to compression of a water-saturated shaft varies from 107.3 to 152 MPa. The resistance to compression of a dry shaft fluctuates from 104.5 to 144 MPa. Shear/sanding resistance ranges from 14.5 to 26.6 cm³/50cm². Frost Resistance/stable/. Sustainability in Na_2SO_4 /stable/. The LA (Los Angeles abrasion test) coefficient fluctuates from 22.85% to 30.0%. The speed or velocity of longitudinal waves fluctuates from 1.45 km/s to 5.02 km/s. On the basis of physico-mechanical parameters the limestone rocks are basically categorized as; relatively strong and very strong rocks. Clay quality-the best clays for bricks and tiles are those that have this content as in table 3.

Table.3. Clay quality

Component	[%]
SiO_2	65 to 72
Al_2O_3	12 to 18
Fe_2O_3	to 6
CaO	around 5

Sufficient quality to see more clays in the Ar1, Ar.4, Ar.11 source. Source clays Ar.10 cannot be uniformly desired, so they seek to be handled more successfully when choosing case choices. Characteristics are the possibility of having clays in the Ar.12 source. The Ar.7 source clays are not a good option. For the optimal clays the required ratio: SiO_2/Al_2O_3 to last less. Likes clays that have a more or less uniform content, withplastic properties, without excellent interference (limestone, sandstone, and in light sulfur).

The wide utilization of limestone and clays has come as a result of the growing demand for more infrastructure and housing facilities. Generally speaking, Limestone and clays were mainly used primarily as a natural raw material for construction, and along with for other industry processes. Limestone rocks in our country have been primarily utilized for the profileration of inerts, cement and lime. The widespread use proves that these rocks have good physico-mechanical features and durability, are extracted and processed at a lower cost than other rocks. In 2011 the urban population comprised 38% (32.5% 1981 and 9.7% 1948), while the rural population was 61.9%. Along with the increase of urban population, the area of settlements has increased, so from 2002 to 2012 it is estimated that the areas of settlements have increased about 8000 ha *(KEPA, 2015)*. Some of the clay products: semi-Mediterranean tiles, covering surface 20x30 cm; chimney blocks (250x190x190) mm; thermo blocks-5 (250x190x190) mm; partition blocks-12 (250x120x190) mm; fert monte M-14 (280x140x250) mm; Duct. Within the 11 year period this amount of limestone was exploited: 517 "M". [m³] in 2005, whereas in 2015 were used 6.531 "M". [m³], an average of 2.665 "M". [m³] ("M"-million). The geological reserves of clays are 27 "M" [tons], (estimated to be even larger). Within the 11-year period, this amount of clays was used: 20,936.29 [tons] in 2005, while in 2015, 104, 170.00 [tons] were used, with an average value of 78,123.99 [tons];

Table.3. Chemical composition and some statistical indicators of limestone in Kosovo

Chemical Compostion	Samples												Min	Ave.	Max
	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12			
CaO	54.01	58.95	53.39	52.3	54.15	54.19	16.44	55	51.96	54.12	54.02	55.3	16.44	51.15	58.95
MgO	0.32	0.56	0.31	0.76	0.76	2.27	28.62	Nil	1.41	0.36	0.33	0.45	0.31	3.29	28.62
Fe_2O_3	0.41	0.14	0.41	0.56	0.19	0.17	0.49	Nil	0.45	0.4	0.4	0.018	0.018	0.33	0.56
Al_2O_3	0.02	0.4	0.02	0.56	1.38	0.12	Nil	Nil	0.15	0.05	0.19	0.05	0.02	0.29	1.38
SiO_2	2.63	0.63	2.53	1.66	0.84	0.87	10.0	0.55	3.44	2.52	2.64	0.36	0.36	2.39	10
L.O.I	42.52	38.23	41.96	42.4	42.59	42.38	44.07	43.2	42.29	42.44	42.44	43.44	38.23	42.33	44.07

*L.O.I.-Loss on Ignition

CONCLUSIONS

Raw materials such as limestone and clays have been explored and are still being explored concerning their quantity, quality and use. Besides that, it is still indispensable taking into consideration the market demand, as well as forcarrying out geological and technological research. Lime and clay reserves are actually large in the territory of Kosovo and represent potential for economic development of the country. Based on the analysis of depicted data of this research, it is indicated that a large number of limestone and clay deposits are in the process of being exploited, while there are also waste resources that have potential and are promising for future. Limestone and clays are widely used in the construction material industry. The construction industry is continuously asking for products made of limestone and clay. Limestone is widely used as a non-metallic material, owing to the fact that it possesses very good technical characteristics and properties so that it can produce good aggregates for concrete and generally stones for construction. The physico-mechanical features of this rock are of satisfactory value for its use as a cornerstone; ballast for all layers of road; saturation; substrates, stabilizers and coatings for asphaltbetone. Clays with good quality are shown at the source: Ar1, Ar.4, Ar.11, while some clay sources require additional assessment measures. The geological reserves of the limestone rock are 361 "M" [m³], (estimated to be even more). Within the 11 year period this amount of limestone was exploited: 517 "M" [m³] in 2005, while in 2015 were used 6.531"M" [m³], an average of 2.665 "M" [m³]. Clay geological reserves are 22 "M" [ton], (estimated to be even more). During the 11 year period this amount of clays was used: 28 thousand [ton] in 2007, while in 2015, 104 thousand [ton], with an average of 63 thousand [ton].

REFERENCES

1. Ahmetaj, I., (1981).Terrenet Krastike në KSA të Kosovës, (faqe 175-206), Bul. i pun. shkenc. i FSHN-Prishtinë.
2. Agjencioni për Mbrojtjen e Mjedisit të Kosovës (KEPA), (2015). Raporti për Gjendjen e Ajrit në Kosovës 2013-2014, faqe 7., Prishtinë.
3. Agjencioni për Mbrojtjen e Mjedisit të Kosovës, (2015). Raporti për Gjendjen e Ujërave në Republikën e Kosovës 2013-2014, faqe 10-11., Prishtinë.
4. Agjencioni i Statistikave të Kosovës, (2020). Vjetari Statistikor i Republikës së Kosovës, faqe 13., Prishtinë, https://ask.rks-gov.net/en/kosovo-agency-of-statistics.
5. Bytyqi, B., (2010). Elaborati gjeologjik mbi karakteristikat e gurit gëlqerorë dhe llogaritja e rezervave në lokacionin "Shume-Groblje" Malishevë.

6. Civil Engeniering Institute "Makedonija" Skopje, departament for materials and roads, (2010), Analizat fiziko mekanike dhe mineralogjike të shkëmbit gëlqerorë në Biraq.
7. Elezaj, Z., Kodra, A., (2008). Gjeologjia e Kosovës, Prishtinë.
8. Instituti i Planifikimit Hapësinor, (2010). Plani Hapësinor i Kosovës, Strategjia e Zhvillimit Hapësinor 2010-2020+, Prishtinë.
9. Jakupi, A., (2005). Metodologjia e Punës Shkencore Kërkimore, Prishtinë (faqe 9-15).
10. KPMM, (ICMM)., (2015). Raporte vjetore 2005-2015, Prishtinë.
11. Konomi, N., Meshi, A., (2007). Raporti i Analizave kimike dhe fiziko-meknike për shkëmbin gëlqerorë në Rainoc, FGJM, Tiranë.
12. Qorri, N., (2005). Elaborati gjeologjik mbi kategorizimin e rezervave të gurit gëlqerorë dhe llogaritja e tyre në "Lugi i Keq"-Vërmicë-Prizren.
13. Shkupi, N.D., (1984). Fjalor i Gjeologjisë, Tiranë, faqe 38.
14. Çadraku, H., Bytyqi, A., (2014). Elaborati për rezervat dhe kualitetin e gëlqerorëve në vendburimin "Udha Drome" në Kaçanik.
15. Çadraku, H., Rexhepaj, B., (2012). Elaborati për rezervat dhe kualitetin e gëlqerorëve në vendburimin "Ngucat" në Ngucat-Malishevë.
16. Çadraku, H., Rexhepaj, B., (2012). Elaborati për rezervat dhe kualitetin e gëlqerorëve në vendburimin "Kleçkë" në Kleçkë-Lipjan.
17. Çadraku, H., et.al.,(2010). Plani i menaxhimit të resurseve minerale të Kosovës, KPMM-Prishtinë.
18. Dushi, M., (2008). Pasuritë minerale të Kosovës-vëllimi i parë, Prishtinë.
19. Fejza, I., Çadraku, H., Sahiti F., (2010). Elaborati për rezervat dhe kualitetin e gëlqerorëve në vendburimin "Qafa e Goleshit" në Minernë-Lipjan.
20. Fejza, I., Çadraku, H., Sahiti F., (2006). Elaborati për rezervat dhe kualitetin e gëlqerorëve në vendburimin "Grab-Semetishtë"-Suharekë.
21. Fejza, I., Çadraku, H., Sahiti F., (2005). Elaborati për rezervat dhe kualitetin e gëlqerorëve në vendburimin "Biraqë"-Suharekë.
22. Fejza, I., Çadraku, H., Sahiti F., (2009). Elaborati për rezervat dhe kualitetin e gëlqerorëve në vendburimin "Grab-Samadragjë"-Suharekë.
23. Gashi, H., (2008). Raporti i analizave kimike për shkëmbin gëlqerorë në Kleçkë.
24. Halilaj, B., Osmanaj I, (2004). Raporti i analizave kimike për shkëmbin gëlqerorë "Lugi i Keq" "INKOS" Obiliq.
25. Tusar, B., (2001). Kamenolomi i okolis, UDK 622.25:581.
26. Vojnogeografski institut. 1984. Osnovne geološke karte Srbije (1:000 000), hartat gjeologjike, planshetet 100 000 për Kosovë, http://geoliss.mre.gov.rs/OGK/
27. Harta topografike për territorin e Kosovës https://www.topografskakarta.com

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MMM Geo Information

CONTRIBUTION OF PROF. DR. PERIKLI QIRIAZI IN THE DEVELOPMENT OF ALBANIAN GEOGRAPHY AND CARTOGRAPHY

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913(496.5)-057.1

ABSTRACT

The development of geo-cartography has attracted a special attention in recent decades. Albanian geographers are also involved in this development, who are constantly contributing to rise geo-cartography in contemporary levels. Through many works, they have not only deepened the knowledge and analysis in the geo-cartography of Albania, but at the same time have continuously supplemented the geographical and cartographic knowledge as a whole.

This article introduces us to the multiple pedagogical and scientific contribution of prof.dr. Perikli Qiriazi in the development of Albanian Geo-cartography and geo-cartography in general. In his scientific work, based on studies and new geographical concepts, prof. Qiriazi analyzes the physical, morphodynamical and bioclimatic bases of Albania and treat natural heritage, karst ecosystems, degradation and desertification of landscapes, the consequences of global warming, climate, and water crisis in Albania, etc. Of special importance are the geomorphological and cartographic studies that accompany the entire geo-cartographic work of prof. Qiriazi.

Keywords: Geography, Geomorphology, Cartography, Perikli Qiriazi, Albania

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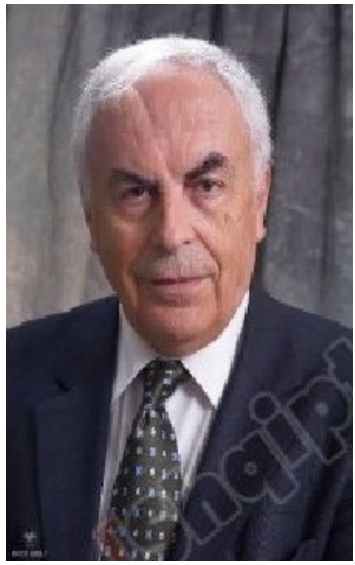
INTRODUCTION

Prof. dr. Perikli Qiriazi is one of the most prominent authorities for pedagogical talent, professional and scientific skills, numerous publications, and tireless work in the field in the discipline of geography and especially Albanian Geography. He is best known for his contributions to the development of geography, geomorphology (Qiriazi, 1987), natural heritage (Qiriazi, 2017), environmental protection, speleology, and thematic cartography, along with the use of natural resources and the planning of land use. As a physical geographer he has been and is active in the search for sustainability in terms of spatial balances, in the analysis of human interactions with the environment, in the interpretation and design of environmental change, etc.



He was born in the village of Podë (Leskovik) in 1944, where he completed his primary education. He completed his seven-year and secondary pedagogical education in Korça (1961). In 1968 he completed his studies in History-Geography at the University of Tirana (UT) with very good results. In 1970 he was appointed lecturer in the Department of Geography at UT, where he worked until his retirement (2011). He is currently an external lecturer at several universities in Albania. He has the scientific degree "Candidate of Sciences" (1983) and the "Doctor of Geographical Sciences" (1993); he has the title "Docent" (1986) and "Professor" (1995). He completed scientific specializations at the University of Bucharest (1975), Paris VII (1987) and Anger (1998), etc.

He is the head of several undergraduate and postgraduate disciplines: Physical and Regional Geography of Albania, Methodology of Physical-Geographical Studies, Natural Heritage of Albania, Degradation and Desertification of Landscapes, Introduction to Regional Geography, for which he has prepared programs and textbooks and has held lectures at several Albanian and foreign universities.

Has headed university and national educational and scientific structures as: head of the Department of Geography at UT (1985–1994); Dean of the Faculty of History and Philology of UT (1997-2000) and of the Faculty of Tourism at UET (2011-2012); member of the Steering Council of the Faculty of History

and Philology (1997–2003) and of its Council of Professors (2006-2011); member of the UT Senate (1997–2003); member and chairman of the National Commission on History and Geography (1997–2000); secretary of the geography editorial office of the Albanian Encyclopedic Dictionary (1976-1980); chairman of the editorial board of the Journal "Albanological Studies" (1997-2000); leader of several doctorates and master's theses, etc.

Prof. Perikli Qiriazi has a wide scientific and publishing activity in the country and abroad. He is the author and co-author of 7 scientific monographs, the Albanian Encyclopedic Dictionary (published by the Academy of Sciences (1980) and its revised reprint (2008)); of the monograph "Geography of Albania" (co-author) in the process of publication by the German publishing house "Springer", 2021; about 100 scientific articles published in the country and abroad; 15 books about the geography of Albania; 5 maps and 2 geographical atlases; 6 university texts and 14 texts for pre-university education, etc. Prof. Perikli Qiriazi is a participant and director of several scientific studies on the geographical problems of Albania, etc.; he has participated with referrals to 40 international scientific congresses and conferences and to 25 national conferences; has participated and directed several environmental projects, etc. He continues to contribute to the recognition and application of contemporary directions in geography and at the same time has initiated the geographical study of the natural heritage of Albania and its inclusion in the curricula of pre-university, university, and post-university education. He co-directed the project "Natural Monuments of Albania" (1996-2000), which was crowned with the National List of Natural Monuments of Albania (Qiriazi, 2005 & Qiriazi, 2007). Currently, he leads the Albanian Scientific Speleological Didactic Association, which initiated the Albanian speleology and, in cooperation with several sister European associations, has discovered and explored many karst caves; has helped in their legal and institutional support and in turning the caves into tourist facilities. In journalism, prof. Qiriazi has raised very worrying environmental problems.

SPECIAL CONTRIBUTION TO THE DEVELOPMENT OF GEOGRAPHY, GEOMORPHOLOGY AND GEOMORPHOLOGICAL MAPPING OF ALBANIA

Equipped with a broad culture and deep knowledge in the field of geography and other related fields, prof. Perikli Qiriazi has given a qualitative impetus to the development of geography in general and the Albanian one, both through the contribution to the development of higher geographical education, as well as through numerous studies with theoretical and practical values. His

contemporary scientific interpretations in many publications in the form of university textbooks, monographs, articles, references, etc., have been evaluated by local and foreign scholars (Qiriazi, 1991). The general features of the relief of Albania and its morphotectonic and morphoclimatic evolution are widely treated in university textbooks and in the monograph published by the Academy of Sciences of Albania (Qiriazi, 1986; Qiriazi 1990; Qiriazi 1998; Qiriazi 2019; Qiriazi 2021). From a comprehensive analysis, Prof. Qiriazi reaches the important conclusion that: "The relief of Albania is distinguished for its pronounced hilly and mountainous character, for the variety of morphological and morphographic forms, for the high degree of horizontal and vertical fragmentation, for the great slope of the slopes, for the complexity and variety of its genetic types. The relief of Albania has passed through two morphotectonic stages: tectogenetic and orogenetic" (Qiriazi 1986; Qiriazi, 1990, Qiriazi 1998; Qiriazi 2019). A special place in his scientific works is occupied by the analysis of morphological features, where prof. Qiriazi states that "In the relief of Albania is characteristic a very pronounced regularity: mountains, ranges and highlands in the west come decreasing and gradually being replaced by hills and plains and in addition, the variety and contrasts of the relief become more slightly pronounced. This morphographic feature of the relief is related to the migration (movement) of orogenesis from the eastern to the western parts of Albania, becoming increasingly weaker in this regard" (Qiriazi 1986; Qiriazi, 1990 Qiriazi 1998 & Qiriazi, 2019). In contrast to other Albanian geographers, prof. Qiriazi has the merit of successfully using morphometric methods in the analysis of analytical parameters of relief fragmentation, giving us the relevant maps for Albania (Qiriazi 1986; Qiriazi, 1990; Qiriazi 1998; Qiriazi, 2019). The physical-geographical regionalization of Albania is also important (Qiriazi, 1989), successfully realized by prof. Qiriazi. In addition, he has analyzed from the geographical, geological, morphometric point of view the whole Central Mountainous Province of Albania and its constituent units such as: the Korça and Perrenjas Pit-fields; The pits of Pogradec, Prespa and Kolonjë (Qiriazi, 1985); Upper Devoll and Upper Shkumbin valleys; the highlands of Mokra, Gora and Kolonja, etc. (Qiriazi, 1986, Qiriazi, 1990, Qiriazi 1998). Prof. Dr. Perikli Qiriazi, in his scientific work, based on studies and new geographical concepts, analyzes the physical, morphodynamical and bioclimatic bases of Albanian territory and, for the first time, deals with:

natural heritage, karst ecosystems, the degradation and desertification of landscapes, the consequences of global warming, the climate and water crisis in Albania, etc. The above elements make the work of prof. Qiriazit, a necessary basis for the formation of geography and history students in Albanian universities. Other researchers as geologists, climatologists, hydrologists, pedologists, biologists, ecologists, environmentalists, etc.; tour operators; natural resource planners and managers; decision-makers and government employees; geography and history teachers; media and those interested in recognizing the physical-geographical features of Albania, in this work, will find the latest scientific information, conceptions and interpretations on these features (Qiriazi, 2019).

Prof. Perikli Qiriazi has a special contribution in the geomorphological studies of Albania where through many works, references, articles, monographs, and other publications he has analyzed the most widespread and developed geomorphological phenomena in Albania, the most general characteristics of the relief, the relief by regions and specific areas, etc. (Qiriazi, 1980; Qiriazi, 1982; Qiriazi, 1985 & Qiriazi, 1988). In these scientific works he has treats in detail the karst and erosion, denudation processes, lithological and structural relief, coastal landscape, etc. (Qiriazi, 1994; Qiriazi, 1997 & Qiriazi, 2003). Thus, he has treated in the necessary breadth and depth the morphology and morphogenesis of the Southeastern Pits of Albania and the surrounding mountains (Qiriazi, 1985). In the extraordinary natural diversity of Albania stand out the karst ecosystems (Qiriazi, 1999) with strange forms of relief, with the chaotic distribution and pronounced contrasts of the surface relief, with the magical and mysterious world of gaps, galleries, labyrinths and numerous underground caves; with confusing and poor hydrographic network, often temporary, but with stormy bloating and immediate drying up, with sudden appearances and disappearances; with the great water wealth inside the karst massifs, which erupts in large springs in their surroundings; with vegetation and special soils and with the various forms of appropriation of natural values by human society living in these landscapes.

The studies about degraded terrains, erosion, river valleys, etc.; for the evolution of geographical landscape, the tectonic relief, etc., are an important part of the scientific activity of prof.dr. Perikli Qiriazi. He has used different methods in geomorphological and regional studies, but the most important are geomorphological mapping and morphometric methods. Prof. Qirjazi has given important speeches at the 28th International Congress of Geographers in the Netherlands (1996), at the International Conferences in Bologna - Italy (1997), Bulgaria (1997), etc.

Prof. Perikli Qiriazi has always used the concepts of Modern Geomorphology established in the nineteenth century as an exercise in the historical interpretation of landscapes and developed as a research to understand the

processes by which landscapes are modified. He considers geomorphology as a 'system science', thus reaching important conclusions on relief forms and their development in Albania. It is important to address the complexities of geomorphological processes and the history of soil forms including the geomorphological role of living organisms, especially microorganisms, the role of climate in geomorphology and the now dominant role of humans as geomorphic agents. In the studies of prof. Perikli Qiriazi occupies an important place the treatments on social and economic human values with the changing environment and human impact on the environment.

Considerable progress has been made in geomorphological and geographical mapping in Albania as well. Thus, several detailed geographical and geomorphological maps have been created for the whole territory and for specific parts of it up to the scale of 1: 25000. A special contribution to the development of geographical and geomorphological cartography has given prof.dr. Perikli Qiriazi. He is the author and co-author in the compilation of: Physical Map of Albania, scale 1: 200 000; Environmental map of Albania, published in Atlas Ost - und Sudosteuropa, published by Osterreichisches Ost - und Sudosteuropa - Institut; Physical map of Albania, published in the Geographical Atlas of the Population of Albania; Map of Albanian Environmental Pollution, published in the Geographical Atlas of the Population of Albania; Map of the Natural Monuments of Albania; Geographical Atlas of Albania, published by IDEART Publishing House, 2010, etc. We also single out the geomorphological map of the Middle Erzeni valley (Qiriazi, 1995) and the geomorphological map of the hilly region around Tirana (Qiriazi, 1990).

WITH OUTSTANDING CONTRIBUTIONS IN THE DEVELOPMENT OF ALBANIAN UNIVERSITY EDUCATION

A special contribution, prof. Qiriazi has given as a lecturer in several geographical disciplines (Geography of Albania, Regional Geography of Albania, Physical-geographical research methodology, Natural Heritage, etc.), but also in drafting and supplementing of the content of geography and geomorphology curricula in the Department of Geography of UT and in other geographical departments of Albanian Universities (Qiriazi, 1978). In collaboration with prof. Vasil Kristo, he has decided the most appropriate criteria for the treatment of the relief of Albania. They have argued that the fairest criterion is the genetic criterion, as in this way the general laws of relief development are better defined and the theoretical foundations of the development of geomorphology are given. This criterion responds better to

the study of the features of the relief of Albania, which is distinguished for the existence of more genetic types of relief of the globe. In the curriculum of Geography department, prof. Kristo and prof. Qiriazi have envisioned the study of relief forms from the point of view of morphography, morphometrics, morphogenetics, evolution and morphochronology, considering the influence of internal and external forces, of factors and processes, geological and climatic conditions, etc. In the early 70s, prof. Kristo and prof. Qiriazi placed in the curriculum of the subject of geomorphology a new chapter entitled "Survey and geomorphological regionalization". This chapter, which consisted of several topics, was a guide to orient the geographers on how to conduct geomorphological studies (what to consider before going to the field, during fieldwork, and how to process materials collected in the field), how to compile partial geomorphological maps and complex geomorphological maps, etc. Later in the geomorphology program took the place "engineering geomorphology or applied" through a chapter entitled "Geomorphological studies in the construction of socio-economic works", which deals with the role of relief and conducting geomorphological studies for agricultural purposes, in the construction of urban works, in the construction of traffic works (roads), in the construction of hydro-technical works, etc. Currently, the methodology and processes of creating geomorphological maps at different levels are included in the curriculum of geomorphology. Professor Qiriazi is the author of several university textbooks on Geography of Albania and geomorphology (Qiriazi, 1988; Qiriazi, 1990; Qiriazi, 2001; Qiriazi, 2011 & Qiriazi, 2019).

The contribution of prof. Qiriazi is also special in dealing with the improvement of methods of teaching geography in school (Qiriazi, 1986; Qiriazi, 1999 & Qiriazi, 2002), designing programs and publishing textbooks for pre-university education. We mention here the textbooks of Geography of Albania and Albanian Territories for 9-year education and general and vocational secondary education (Qiriazi, 1979; Qiriazi, 1984; Qiriazi, 1988; Qiriazi, 1993; Qiriazi, 2000; Qiriazi, 2002; Qiriazi, 2003; Qiriazi, 2007; Qiriazi, 2010 & Qiriazi, 2011).

PROFESSOR WITH SPECIAL CONTRIBUTIONS

For excellent work as a lecturer and director of several university structures and for the high level of his pedagogical-scientific preparation, prof. Perikli has been awarded the title "Docent" since 1986 and later the title "Professor". He was honored with the order of Naim Frashëri III (1984) as well as a series of other medals. Prof. Perikli Qiriazi has given an extraordinary contribution

to the development of the branch of geography, in terms of preparing plans and curricula of this branch, in the preparation and publication of lectures and textbooks on geography, geomorphology, cartography, etc.

During his teaching-scientific activity he has prepared dozens of titles of books of university and postgraduate level which have been published, revised and republished several times. He has prepared hundreds of scientific articles published in scientific bulletins in Albania and abroad. He has prepared monographs and scientific studies, is co-author of the Albanian Encyclopedic Dictionary, Publication of the Academy of Sciences, etc. He has never been detached from participating in the study work of the Department of Geography in cooperation with the different institutions. He has led and participated in several studies such as: areas of formation of avalanches in Albania and safeguards to them, environmental relief and environmental strategy studies, on the state of the environment in Albania, about the tourist potentials of the Saranda area (Lukovë - Konispol), the tourist potentials of the Pogradec area around Lake Ohrid, the tourist potentials of the Prespa - Kapshtica area, natural hazards in Albania (Natural hazard map , scale 1: 200.000 and its explanatory text), geological-engineering map of Albania in scale 1: 200.000, strategy and action plans for the protection of biodiversity in Albania, Protected areas of Albania - problems of the current situation and management them, nature monuments of Tirana region, nature monuments of Gjirokastra district, nature and culture monuments of Skrapar district, geographical features of Dajti National Park, karst ecosystems of Albania, environmental problems of the area Tirana - Durrës, etc. Also, prof. Qiriazi has made environmental impact assessments of several engineering projects such as: construction of the Durrës - Kavaja Highway, construction of the liquefied gas plant and TPP in the coastal area Darzezë - Vija e Ngjalës (Fier); construction of hydropower of Dardha (Puka), on the river Çemerica, in the cascade of rivers: Drini i Zi, Vjosa, Devoll and Osum, in the cascade of the river Suha, Shala and Cem, on the river Ziu (Puka), etc.

Prof. Perikli Qiriazi is a well-known in the Albanian academic world up to the international arena with studies and geo-cartographic analyzes materialized as material (several hundred study pages, documents, etc.); as fields of study (geography, geomorphology, natural heritage, cartography); as a subject (published, in manuscript, translated, adapted) etc. Prof. Perikliu distinguished as organizer and coordinator of academic and scientific activity. He is known for his simplicity, sincerity, exemplary correctness, and dedication. He is one of the most excellent methodologists in Albanian higher education, who with his model lectures, leaves an indelible impression on all students who assist in his fluent, concise lectures and with a high scientific

level. Prof. Perikliu is a rare model of human and scientific behavior and communication and is distinguished for an unparalleled dedication in transmitting geo-cartographic knowledge to students and all other specialists. He is a complete scientist and scholar, a dedicated and tireless researcher, a rare leader of scientific research and initiatives.

CONCLUSIONS

In the generation of Albanian geographers, should be singled out Prof. Perikli Qiriazi, who is dedicated with perseverance and passion to University lectures and geographical studies. He is distinguished in the history of Albanian Geography for his ideas and theses in the geographical regionalization of Albania (Qiriazi, 1996), methods of geographical and geomorphological studies, geomorphological mapping, caves, and their treatment (Qiriazi, 2007), classification and protection of nature monuments, protection and development of the environment, etc. His publications are original and illustrated with Albanian geographical and geomorphological phenomena, unique where theory is organically intertwined with theoretical interpretations. Thanks to his professional training, work, and persistent character, he has reached original conclusions and theses with special scientific values. Even today, prof. Perikli Qiriazi works tirelessly and with tremendous passion. With his work he has contributed and is contributing to the successful development of geo-cartography in general, especially of Albania Geography.

REFERENCES

1. “Gjeomorfologjia”: Tekst për Fakultetin e Gjeologjisë. Botim i Universitetit te Tiranës, 1988.
2. Anmerkungen zu zwei konzepten der physisch - geographischen Gliederung Albaniens. Bamberger Geographische Schriften, Bd. 10. Bamberg 1991.
3. Disa dukuri gjeomorfologjike të maleve të Moravës, Buletini i Shkencave Gjeologjike, Nr. 3, 1982. Botim i Institutit të Studimeve dhe Kërkimeve Gjeologjike dhe Minerare.
4. Dukuri gjeomorfologjike të luginës së Shkumbinit të Sipërm, Studime Gjeografike. Nr.3,1988. Botim i Akademisë së Shkencave - Qendra e Studimeve Gjeografike.

5. Dukuri gjeomorfologjike të Pellgut të Kolonjës. Revista "Përmbledhje Studimesh" nr. 4, 1980. Botim i Institutit të Studimeve Gjeologjike dhe Minerare.

6. Ecuria Metodiko - Shkencore e disa punëve praktike gjeografike në shkollë. Revista "Lëndët Shoqërore në Shkollë", nr.8, 1986, Botim i Insitutit të Studimeve Pedagogjike, (bashkëautor).

7. Ekosistemet Karstike të Shqiperisë (1999). Shtëpia Botuese Fan Noli dhe fondacioni SOROS.

8. Environmental problems of Albania, botuar në Österreichische Osthefte, Österreichische Ost-und Südosteuropa – Institut, Jahrgang .Wien 2003, Heft.

9. Environmental Situation in Albania. The Ecological Rekonstruction of Estern Europe - National and International Contributions nga GLOBAL 2000 Institute for Environmental Research, Haling Vienna, Austria, 1994.

10. Geomorfology peculiarities of the Albanian Adriatik Coastline, nr. 3, 1997. Botim i Akademise se Shkencave.

11. Gjeografia Fizike e Shqipërisë (bashkautor dhe redaktor shkencor).Botim i Akademisë së Shkencave, Tirane, 1990. 1100 faqe, përpiluar 100 faqe.

12. Gjeografia Fizike e Shqipërisë, botim i Shtëpisë Botuese Mediaprint, 2019.

13. Gjeografia Fizike e Shqipërisë, ribotim i përpunuar, 2019.

14. Gjeografia Fizike e Shqipërisë, ribotuar në vitin, 2001, 2004, 2006. 2011 Tiranë.

15. Gjeomorfologjia e Gropës së Prespës së Madhe. Revista "Studime Gjeografike", nr.1, 1985, Botim i Akademisë së Shkencave - Qendra e Studimeve Gjeografike.

16. Harta gjeomorfologjike e luginës së Erzenit të Mesëm. Revista "Studime Gjeografike", nr. 7, 1995. Botim i Akademisë së Shkencave - Qendra e Studimeve Gjeografike, (bashkeautor).

17. Harta gjeomorfologjike e rajonit kodrinor përreth Tiranes. Revista "Studime Gjeografike", nr. 4, 1990. Botim i Akademisë së Shkencave - Qendra e Studimeve Gjeografike, (bashkeautor).

18. Il carsismo nei gessi del territorio albanese, Gipsum karst areas in the World,: their protection and tourist development, Memorie dell'Instituto Italiano di Speleologia, Serie II, vol. XVI, Bologna, 2004.

19. Issue affecting conservation of biological and landscape diversity. "The mountains of Central and Eastern Europe". IUCN, Gland. Switzrland and Cambrige, UK. 1995.

20. L'area archeologica di Shpella e Tren. Nuove ricerche in albania 'Shpella e Tren': una grotta archeologica ancora da scoprire, bashkautor, "Speleologia", Milano, 2007.

21. La regionalisation fisico - geographique de l' Albanie de la periode de Herbert Luis jusque de period de present. Referat i mbajtur ne Konferencen shkencore "Albanien", organizuar nga Departamenti i Gjeografise i Universitetit te Bambergut, Gjermani, 1989.
22. L'Albanie, terre d'exclusion, pays d'espérance - Traveaux du CARTA. Laboratoire de Geographie Humaine et Sociale Université d'Angers UMRS ESO CNRS - Annee 1999.
23. Les activitées humaines et la degradation des montagnes en Albanie, Observatoire de Montagne de Moussala OM2, Sofia, 1998.
24. Les activities humaines et la degradation des montagnes albanais, Simpoziumi Nderkombetar Omz, Borovetz (Bullgari), 15 - 18 tetor 1997;
25. Les mouvements de Terrain en Albaniaet et le Rôle de l'Homme Transactions Japanese, Geomorphological Union, Volume 20, Number 3, May 1999. Selected Papers on Landslinde Management presented at ICG, Bologna.
26. Les problemes de Milleu de l' Albanie. Osterreichische Osthefte, Osterreichische Ost - und Sudosteuropa - Institut. 1994.
27. Major Environmental Problems in Albania, Remonte Sensing for Environmental Data in Albania: A strategy for Integrated Management, NATO Science Series, Environmental Security - Vol. 72, 2000 Kluwer Academic Publisher, Dordrecht/Boston/ London.
28. Metodika e Kërkimeve Fiziko-Gjeografike. Tekst për gjeografët. Botim i Universitetit të Tiranës, 1987.
29. Monumentet e natyrës së Shqipërisë, botim elektronik, Tiranë, 2005, bashkëautor.
30. Monumentet e natyrës shqiptare, album në shqip dhe anglisht, bashkëautor, 2007.
31. Morfologjia dhe morfogjeneza e Gropave Juglindore dhe e maleve përreth. Botim i Universitetit te Tiranës, Tiranë, 1985, 200 faqe.
32. Natural and anthropogenic hazards in karst areas of Albania, Natural Hazards and Earth System Sciences, Sref-Id: 1684-998 l/nhess/2004-4-569, Europian Geosciences Union 2004.
33. Natural monuments of Prespa region, their values and possibilities of management (bashkeautor) - International Symposium Sustainable development of Prespa region - Proceedings - Oteshevo 23 - 25 Qershor 2000;
34. Probleme mjedisore në Shqipëri, Kurrikula e Gjeografisë dhe e historisë në shkollë, Botim i ISP, Tiranë, 2002.
35. Probleme të teksteve të gjeografisë të vendeve ballkanike. Seminar i organizuar nga Instituti i Studimeve Ballkanike. Tiranë 27 Shtator 1999.
36. Proceset dhe format aktuale gjeomorfologjike të brezit bregdetar në sektorin Kepi i Lagjit - Bishti i Pallës, bashkëautor, Studime Gjeografike,

nr.10., 1997. Botim i Akademisë së Shkencave - Qendra e Studimeve Gjeografike.

37. Rajoni gjeografik dhe faktorët e diferencimit rajonal të hapësirës gjeografike, Kurrikula dhe Shkolla, Histori - Gjeografi, nr. 3, Botim i ISP, Tiranë, 2003.

38. Rajonizimi gjeografik i Shqipërisë. Studime gjeografike, nr.8, 1996. Botim i Akademisë së Shkencave - Qendra e Studimeve Gjeografike.

39. Tiparet themelore gjeomorfologjike te Shqiperise dhe disa probleme te praktikes. Revista "Studime Gjeografike", nr.2, 1987. Botim i Akademisë së Shkencave - Qendra e Studimeve Gjeografike.

40. Trashëgimia natyrore e Shqiperise, Botim i Akademise së Shkencave, 2017.

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