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ANALYSIS OF THE TERRITORY OF THE DYKANKA COMMUNITY IN ACCORDANCE WITH SUITABILITY FOR CONSTRUCTION

The use of modern technologies greatly simplifies the calculation and analysis of data that we use for further use in planning and construction. A study was conducted to determine favorable locations for construction activities. 80.6% of suitable territories for construction, 15% less suitable, 4.4% unsuitable. The use of QGIS to construct a slope map is shown. A histographic image is displayed for data visualization.
***Keywords*: QGIS; slope maps; suitability for conctruction.**

1. Introduction. QGIS is a powerful and free geospatial analysis tool that can be used for a variety of tasks, including slope mapping. Visualization of topographic and geological data is a key aspect for identifying favorable locations for agriculture, mining and other activities that require knowledge of the landscape. The slope of the territory is one of the most important parameters when studying natural resources, as well as when planning infrastructure, building roads and other engineering structures.

In this context, the QGIS program provides convenient and powerful tools for terrain analysis and construction of slope maps. It allows you to work with different types of data, such as digital terrain models, aerial photographs, satellite images and others, which can be used to obtain accurate data about the slope of the territory. With QGIS, you can visualize slope data, conduct risk zone analysis, and perform other geospatial analyzes that provide a detailed landscape study.

Using QGIS to build slope maps is an effective tool for identifying favorable locations for various activities.

2. Background and Related Work. Researchers from Malaysia were studying population dynamics and it's impact on ecosystem, including it's relation to water availability. They were using QGIS for to improve utilization of drinking water, so that companies that provide regional services would have better impact. In their research the number of overall consume were estimated and result for pipe pressure as well [1].

Researchers from Pakistan were studying how rapid urbanization is changing the existing patterns of Land Use Land Cover (LULC) globally which is consequently increasing the Land Surface Temperature (LST) in many regions. Study shows how climate change changes agriculture and suggest urban plantation to counter. Validations modules were made in QGIS and IDRISI [2].

Researchers from Indonesia were using QGIS for Bontang City GOS mapping for the provision of geospatial information on lite. Their study aims to propose a platform application of GIS Cloud Computing (CC) of Bontang City GOS mapping. The GIS-CC platform uses the basic map available that's free and open source. Digital mapping techniques are available freely and openly so that map-based application development is easier, faster and cheaper [3].

Researchers from India were using QGIS 2.18.24 and it's MOLUSCE plugin (MLP-ANN) to identify the changeover of land-use changes in the Bhavani basin for the two periods 2005 and 2015 and to forecast and establish potential land-use changes in the years 2025 and 2030. The five criteria, such as DEM, slope, aspect, distance from the road, and distance from builtup, are used as spatial variable maps in the processes of learning in MLP-ANN to predict their influences on LULC between 2005 and 2010. The projected and accurate LULC maps for 2015 indicate a good level of accuracy, with an overall Kappa value of 0.69 and a percentage of the correctness of 76.28%. MLP-ANN is then used to forecast changes in LULC for the years 2025 and 2030, which shows a significant rise in cropland and builtup areas, by 20 km^2 and 10 km^2, respectively. The findings assist farmers and policymakers in developing optimal land use plans and better management techniques for the long-term development of natural resources [4].

Despite the importance on the use of QGIS on the scientific community, to date there are no systematic studies indicating how the acceptance of this software has evolved through time. Therefore, the objective of researchers from Mexico was to characterize the scientific production and extent where QGIS has been used as their main

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geospatial tool. They conducted a bibliometric analysis of documents published in Scopus from 2005 to 2020 (931 manuscripts), the annual rate of publications increase was 40.3%. They found strong and positive correlations regarding the number of contributing code programmers (r=0.66, p0.005); and the total income of the QGIS project (r=0.88, p0.001). Seventy-two percent of the publications were included in six fields of study, being Earth and Planetary Sciences the most representative. Italy was the country with larger scientific production, while the USA was the most influential country (being the first, regarding the number of citations). In terms of the countries, the larger number of papers found were from Portugal, Italy, Brazil, and France. The International Archives of the Photogrammetry Remote Sensing and Spatial Information Sciences – ISPRS Archives stands among journals with the largest number of publications (47). In terms of collaborative networks among countries, we found strong links between authors from Germany, Switzerland, Greece, and Spain. Author network analysis showed three solid networks in different fields of study. We observed a favorable trend in the acceptance of QGIS across the world and a widespread development of collaborative networks. The present paper allowed increase the knowledge of geographic information systems, especially the development of scientific production using QGIS [5].

QGIS evolving each day and many researches using it not only to their studies, but to improve program. QGIS is being improved by Machine Learning (ML) algorithms to be used as an alternative to conventional and geostatistical methods in digital mapping of soil attributes. In this case study, soil attributes with R^2 values ranging from 0.05 to 0.83 and RMSE ranging from 0.07 to 12.01 were predicted by the methods tested [6].

There is study from India using QGIS to analyze problems such as road condition, traffic congestion, road blockage, road accidents etc. Digitization of the road network and its analysis can therefore be an effective tool towards resolving these issues. The free and open-source software Quantum Geographic Information System (QGIS) is well suited for such an analysis [7].

The goal of this work is to develop the methodology and use of the analysis on the favorability of construction in the geoinformation system QGIS. Using the algorithms of the software, we will calculate the slope of the territory of the community by downloading the map from the plugin (QuickOSM).

3. Research Methodology

Digital Elevation Model (DEM) analysis. Task: Construction of a map of the slopes of the territory to determine zones favorable for construction. Let's formulate the method of performing the task.

Stages of Solution:

➢ Data preparation (Making of DEM)

➢ Determination of relief slopes on the territory of the settlement: 'Slope'.

➢ Classification of the obtained slope raster according to the groups defined by the standards: 'Reclassify by table'

➢ Calculation of statistics and data in particular on the area occupied by each category of territory: 'Raster Layer Unique Values Report.

➢ Processing of results.

4. Results. To determine areas favorable for construction, we can classify the DRM of the area by slopes. For this, we will use the requirements for slopes from State Building Regulations of Ukraine B.2.2.-12:2019 "Planning and development of territories" (Table 1).

Table 1

Requirements for the slopes from State Building Regulations of Ukraine

Slope	Favorable for construction	Less suitable for construction	Unfavorable for construction
	0.5–8%	Lower than 0.5–15%	Bigger than 15%

The DEM layer is cut along the boundaries of Dykanka community (Poltava region, Ukraine) of the high points. Then we convert the point layer into a polygonal layer by building its extent: Concave shell (alpha-form). Cut the DEM using the resulting polygon: Clip raster by Mask Layer. Choose the same resolution of the resulting layer as the input layer.

Let's build a slope raster (Fig. 1) – Slope map – tool "Slope". The slope is expressed in percentages instead of degrees, calculated on the limits. The ratio is 1.00.
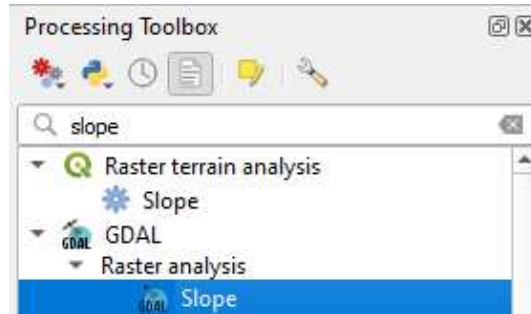
Fig. 1. Tool "Slope"

After obtaining a gradient raster, using the tool for obtaining information we can get information about the gradient at any point of the raster: Raster classification by slopes, using with tool "Reclassify by table". Indicate the limits of the range min <= value <max and enter data into the table (Fig. 2).
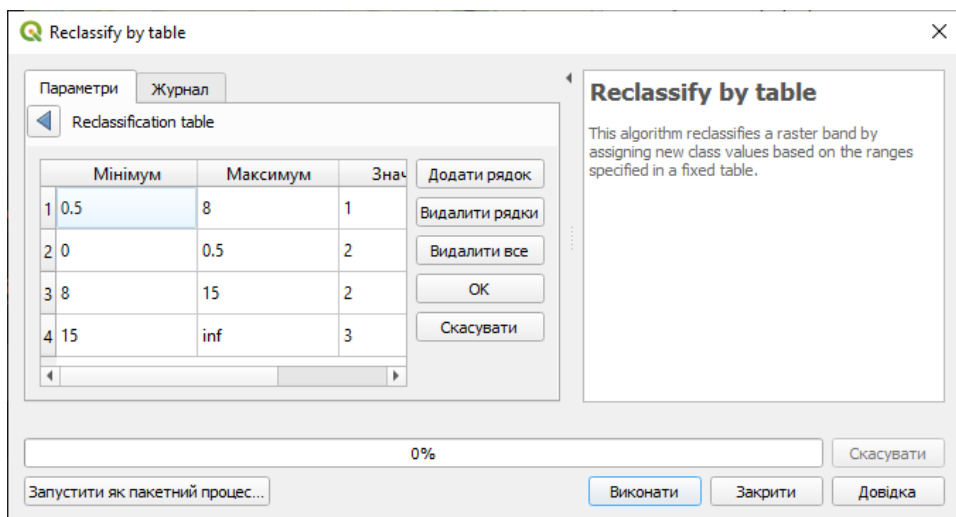

Fig. 2. Algorithm Reclassify by table

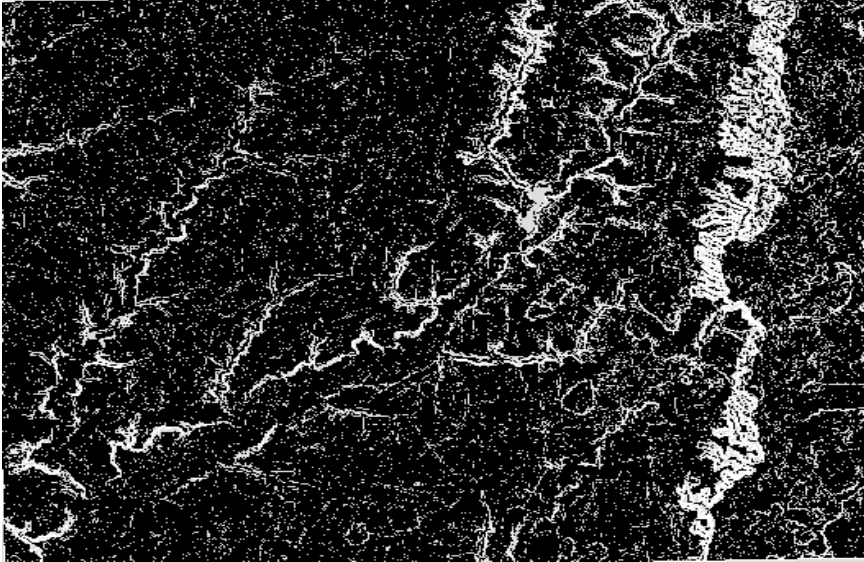Obtaining a reclassified raster (Fig. 3).

Fig. 3. Reclassified raster

Cropping of the classified raster within the settlement using the tool Clip raster by Mask Layer, connecting it to the extent of the cropped mask layer and changing the symbols (Layers Properties) to visualize information about slopes.

Obtaining information about the areas of the territories from the raster is carried out by the "Raster layer unique values report" after that we will receive a link with information (Table 2).

Table 2

Value pixel count area (m^2)

№	The number of pixels	Area (m^2)
1. (Favorable for construction)	856129	549649005.0593675
2 (Less suitable for construction)	158861	101991394.5126683
3. (Unfavorable for construction)	46679	29968691.52565351

We perform statistics with a function Zonal Histogram. In the attribute table (Table 3) we can view the area of the created file "favorable" (Histo1), less suitable (Histo2) and unfavorable (Histo3) territory for construction.

Table 3

The area of suitable, less suitable and unsuitable territories by slope

HISTO_NODATA	HISTO_1	HISTO_2	HISTO_3
47127	1695062	1528084	1376213
1441364	469	846	1809

We can visualize these statistical data in the form of a diagram. Let's go to the properties of the Output zones layer, the Diagrams tab and create a diagram.
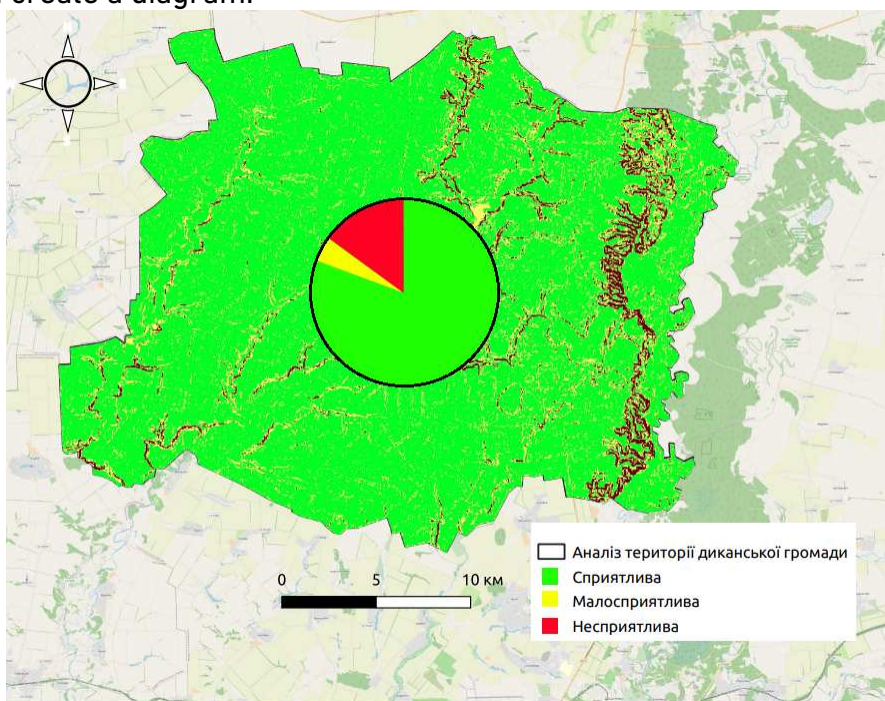

Fig. 4. Preparing the file for printing and add conditional notations

QGIS is an open source program, which means that it is available for use for free and open source, and can be modified and distributed according to the license terms. Most of the features available in commercial GIS applications such as ArcGIS and MapInfo are also available in QGIS, making it quite competitive in this market segment.

QGIS is a powerful geospatial data analysis tool that can be used to study the suitability of an area for construction. With QGIS you can display different layers of data, such as geological, environmental, transport and others, on a single map and analyze their interaction.

For example, QGIS allows you to perform spatial planning analysis, including the identification of risk zones, constraints and land use zones, which can be useful in determining suitable sites for construction. Also, with the help of QGIS, it is possible to analyze various aspects that can influence the choice of a place to build, such as accessibility to infrastructure, natural conditions, demographic and social factors.

5. Conclusion. The use of modern technologies greatly simplifies the calculation and analysis of data that we use for further planning to build constructions. The use of the QGIS software complex allows us to examine the territory of the community to analyze the suitability for construction, which significantly speeds up the further planning of projects. A study was conducted to determine favorable locations for construction activities of the Dykanka community (Poltava region, Ukraine), research results: 80.6% of suitable territories for construction, 15% less suitable, 4.4% unsuitable. The use of QGIS to construct a slope map is shown. A histographic image is displayed for data visualization.

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АНАЛІЗ ТЕРИТОРІЇ ДИКАНЬСЬКОЇ ГРОМАДИ НА ПРИДАТНІСТЬ ДЛЯ БУДІВНИЦТВА

Використання сучасних технологій значно спрощує розрахунок та аналіз даних, які ми використовуємо для подальшого використання при плануванні та будівництві. Було проведено дослідження для визначення сприятливих місць для будівельних робіт: 80,6% територій придатних для будівництва, 15% менш придатних, 4,4% непридатних. Показано використання QGIS для побудови карти схилів. Для візуалізації даних відображається гістографічне зображення.

Ключові слова: QGIS; карти схилів; придатність до забудови.

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