

**National University of Uzbekistan**

# **REPORT**

*on online study in the frame of the Erasmus+ DSinGIS project*

*(February 10– April 10, 2021)*

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***Mentor:*** Dr. Daniel Mueller

**TASHKENT, 2021**



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## Introduction

It is known that at present, among all spheres, modern programming languages and technologies have entered cartography, which contributes to the more rapid development of the sciences of this sphere. An example of this is the platform that works based on artificial intelligence and mobile navigation maps that are used daily. This is because they are user-friendly and can be easily used in places with a good-quality Internet connection. In particular, on platforms that are based on such artificial intelligence, there is an opportunity to search, zoom in, or out on the specified scale of the image (spatial coverage), move the streets, and perform other functions like these. Almost all cartographic works of such a new format are created based on the Python programming language and ArcGIS Online Platform.

With the coordination of the Leibniz Institute of Agricultural Development in Transition Economies (IAMO), the project "DSinGIS: Doctorate in Geoinformation Sciences" is being implemented within the framework of the Erasmus + CBHE program. The main aim of this project is to support Uzbekistan in sustainable development by GISc. The project offered scholarships to researchers and PhD candidates for partner HEI of Uzbekistan. These scholarships provide the opportunity for the candidates to embark on a two-month stay at one of the three European partner institutions where they further their research project under supervision of and in close collaboration with the selected mentors from the European institution.

I was awarded one of these scholarships to do research under supervision of Dr. Daniel Mueller at the Leibniz Institute of Agricultural Development in Transition Economies (IAMO) for the period February 1st to March 31st, 2020.

Unfortunately, due to COVID-19, I was unable to trip to the Hungary. We just had to wait, because our trip was depend on how the situation with COVID-19 will change. However, the situation had not improved, and project was coming to an end. Based on the situation, the PAB suggested conducting the study online and this was accepted as a decision.

From the beginning of this decision, I discussed my mobility plan with Dr. Daniel Mueller, and we agreed to prepare a scientific article on the topic of "Issues of application of GIS and it technologies in the creation of cartographic works (On the example of the atlas of horticulture and viticulture of the Republic of Uzbekistan)", as well as take part in the GISCA 2021 conference (<https://www.aca-giscience.org/pages/gisca-2021-agenda>).



## Study Plan

Here, below study plan is given:

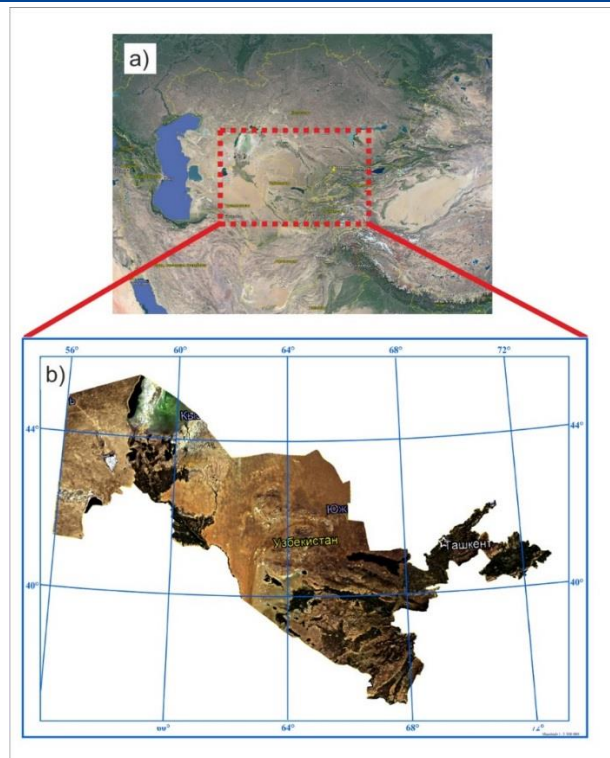
### Planned research activities and work plan

№	RESEARCH GOALS	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8
1.	Preparation of research paper (Improving creating map of horticulture and viticulture in GIS)								
2.	Analyse scientific researches published by experts in the field of research and collecting data of the research object, Development of data processing, mapping technology in ArcGIS.								
3.	Finish writing a scientific article								

### The study area and methods

The development of horticulture and viticulture in Uzbekistan is an important geographic role. Uzbekistan is located in the southwest of Central Asia.

Since the soil and climatic conditions of Uzbekistan are different in each region, it is possible to grow high-quality fruits, Vine seedlings, and dressing on a scientific basis only if the rules of agrotechnical developed there The climate of Uzbekistan is sharply Continental, and its drastic variability is inextricably linked with the geographic location of the regions, its release, the intensity of the solar radiation, the influence of atmospheric circulation. As the area of the country stretches from north to south for 925 km, the sun's rays do not fall evenly. In the northern regions, in summer, the sun rises from the ground level to 71°, in the south, it rises to 76°. If the duration of sunny days is 2500-2800 hours in the North and 130 kcal/sm<sup>2</sup> during the year, then in the south this figure is 300-300 hours, as well as 160 kcal/sm<sup>2</sup>.



**Figure 1.** The location of the research object: a) Central Asia. b) the Republic of Uzbekistan

After the geographical description of the area which is being mapped, the next step is the design and development of a set of technical tasks. In particular, the work on the design of cartographic web products can be carried out in different spatial coverage (from global to ultra-local) following the purpose of the atlas, and they have the following conveniences: 1) ability to combine different types of data (cartographic, graphic, textual, visual, etc.) related to the subject; 2) ability to update data quickly and on time (including without changing the location and email address of the Atlas). Work on the creation of such atlases is carried out mainly in two different ways: 1) with the help of a special operator, 2) automatically; 3) multiplied free of charge and distributed quickly and easily; 4) it contains a wide range of data on the subject, which in turn allows to analyze, evaluate and make automatic forecasts for the specified periods [17, 16].

In general, the term "Web cartography" refers to the field of computer technology that provides access to spatial information for the user and provides the ability to interactively (interactively) compile and edit maps with the help of special tools [15].



The standard interface of the OpenGIS® Web Cartography Service (WMS) over the web is based on a simple HTTP interface to provide geographically linked map images from one or more distributed geospatial databases. A database management system (WMS) defines the geographic layer (s) and the circle of people interested in processing them. A response to a request in the format of one or more geographically registered maps can be via a browser and provided to the user in the required format (JPEG, PNG, etc.). The interface also can specify that images should be transparent, and it determines whether to merge layers taken from multiple servers. [21].

A set of web maps that are placed on the Internet and developed based on established requirements and laws, in turn, will form a web Atlas. And this is a different view of the electronic atlases, the methods of creation, differ in some way in their requirements. The main distinguishing feature of such atlases and their main advantage is their interactivity, which first of all attracts the attention and interest of the user [6].

### **Collection of information**

Cartographic Web helps to carry out several functions related to spatial data, including the collection, storage, editing, processing, management, analysis, and visualization of the data of products.

Currently, the creation of electronics, including web atlases, is widely used in various fields of activity, in particular in the field of Environmental Protection, tourism, and objects of cultural heritage, agriculture, and many others. Accordingly, this research work is concerned with the creation of an online platform – web Atlas, which expresses the gardening and viticulture potential of the Republic of Uzbekistan.

In many Internet networks, modern scientific literature, many web atlases created in different directions and themes can be viewed. But they differ from each other in content, purpose, structure, territory, and other aspects of the map.

Below we will look at the thematic web atlases developed to this day. For example, the web Atlas [14] of the Altai-Sayan region contains information about all individually protected objects of the territory that are mapped. Else, the atlas contains information on the climatic characteristics of the territory near the protected areas, normative legal acts related to the protected areas of the region, and scientific and technical reports. At the same time, additional thematic layers have been developed to the higher level of protected areas (Reserve, National Garden).

As an example of another wide-coverage Atlas of protected areas, it is possible to indicate the Atlas of protected areas of St. Petersburg [2], which contains



information about all protected areas on the borders of the city (from the largest reserves to the smallest natural monuments). The peculiarity of this atlas is characterized by the presence in it of a large number of materials - photographs, diagrams, profiles, etc.

In addition to the creation of atlases of protected natural areas, it is possible to find several examples of atlases that can be created for individual, large-scale, protected areas, or some types of protected areas (biological, geological, geological).

For example, as a separate electronic atlas, it is dedicated to the Ugra National Park [1], which is located in the Kaluga region. This atlas is intended for a wide range of users and serves as a visiting card of the National Park. A distinctive feature of the Atlas is that it not only reflects the natural features of the protected area but also contains information about the cultural and historical features of the development of the National Park.

Summarizing the above said about the web cartographic works studied, it is worth noting that at present many of the web atlases created as a result of such research have been developed on the theme of Environmental Protection. However, there is no web cartographic work in Uzbekistan, which has not yet included extensive coverage of horticulture and viticulture.

Thus, nowadays, the creation of electronic atlases on different themes in different regions is of urgent importance, which includes not only natural themes but also web atlases on a socio-economic theme and information that characterizes their features. In particular, some thematic maps of the area of garden vineyards in the Republic of Uzbekistan, gross yield, yield, varieties of horticulture and viticulture, their public procurement, their processing, and so on are designed.

In this research work, ideas on the methodological basis of web Atlas creation based on the harmonization of IT and GIS technologies of the horticulture and viticulture Atlas of the Republic of Uzbekistan are described.

## **Methods**

To create a web Atlas, initially in the program ArcGIS 10.6 created a geographic basis based on the universal map of the Republic of Uzbekistan, the remaining thematic maps will also be developed on this geographic basis.

Legends of maps are developed, geoinformation technologies are used in their development. Through GIS technologies, layers are formed. According to the formed layers, elements of content are developed. In the creation of maps based on GIS



technologies, work is carried out according to the processes of planning, data analysis, presentation, editing, and publication [7].

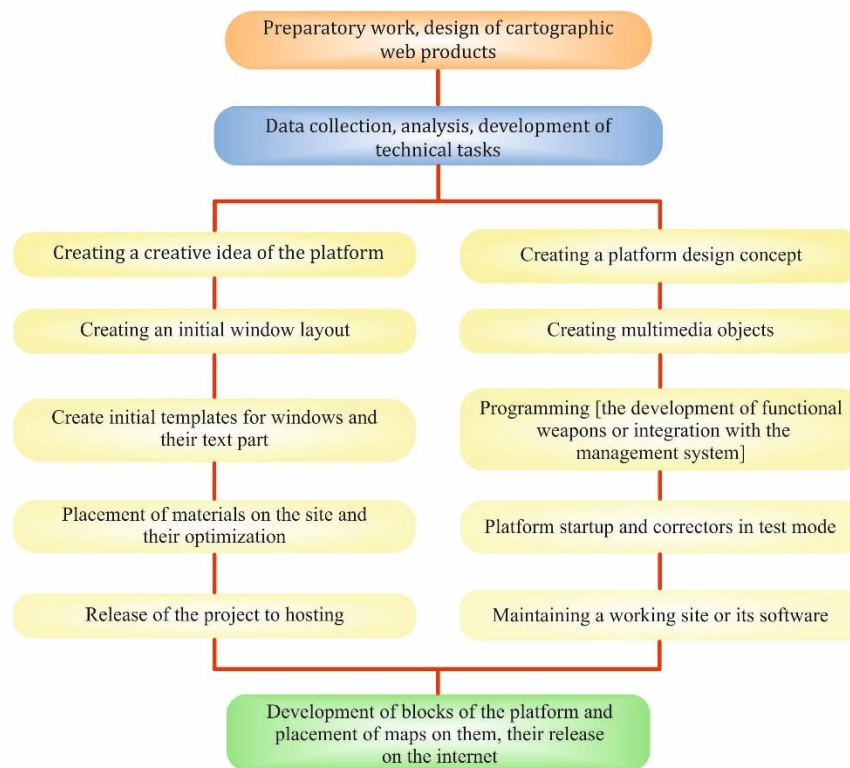
The extent to which the content of each map in the web atlas project fully describes the different elements is mainly dependent on its purpose, theme, and scale. Maps on "Design and construction of horticultural maps" are intended to acquaint readers with information such as the extent to which the population of our country is provided with horticultural products, the location of horticultural areas throughout the territory, their indicators in rural and urban areas.

The latest developments in Atlas maps occupy an important place in the description of events, their delivery to readers, and specialists of the horticultural industry.

Maps must meet the following requirements:

- a complete description of the current state of the place and its features;
- be visually and comfortable to read;
- providing all information related to the topic of this map;

Maps may also include additional inset maps. For instance: geological, climatic, soil, plant, nature conservation, etc.



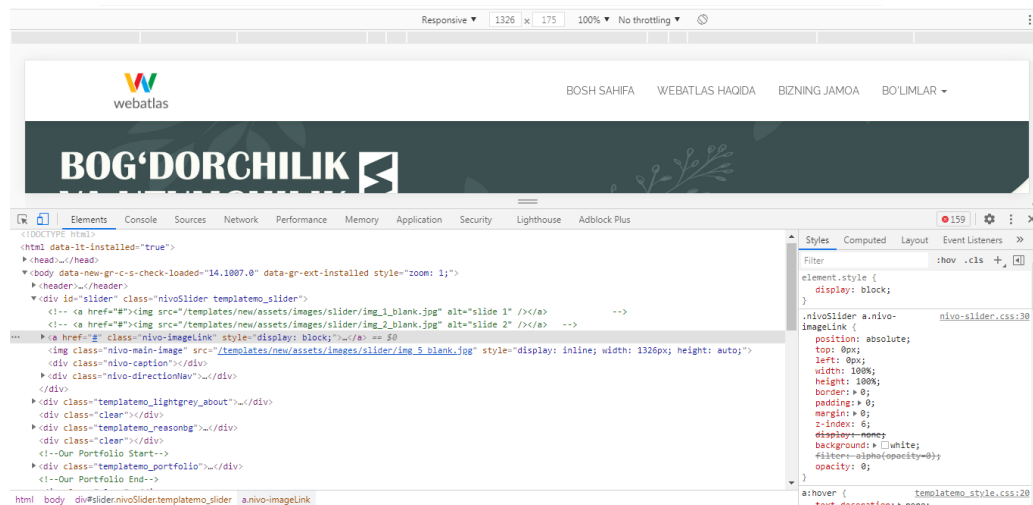
**Figure 2.** Cartographic web product creation scheme



After that, work will begin on placing thematic maps created on the basis of GIS programs in the sections prepared on the platform. When creating platforms, the work is divided into two main parts: "Front-end" and "Back-end".

"Front-end" is the practice of converting data into a graphical interface using HTML, CSS, and JavaScript to view and interact with data.

"Back end" is the "back" part of the site, which is not visible to users, but is the part that directly affects the operation of the site and is primarily responsible for its operation.



**Figure 3.** The process of forming the user interface of the gardening and viticulture web Atlas

Through these languages, the transformation of the web Atlas into visible parts, dimensions, depending on the size of the screen of the device used has been developed. The colors in the user interface of the platform and the raster images used were developed based on special graphic editors, and when creating them, programs from the version of CorelDRAW X7, Corel PHOTO-PAINT X7, Adobe Photoshop CC 2015 were used. Based on the RGB (Red, Green, Blue) color model, when displaying the color harmony on the site, it is specially selected for the site, taking into account the aspect ratio of the colors.

## Results

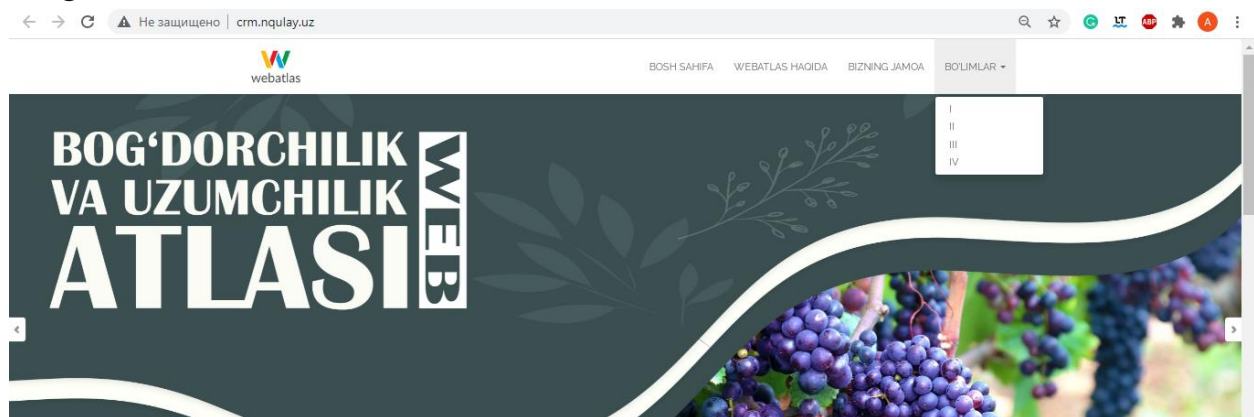
Based on the created database, it is planned to create interactive maps on the theme of horticulture and viticulture reflecting the potential of the Republic and its indicators in the regions. Thus, as a result of the collecting of a large amount of cartographic materials, the idea of combining the created interactive maps in a single web shell was realized by creating a web Atlas of gardening and viticulture.

Currently, the preparation of the user interface of the web Atlas of horticulture and viticulture ("Front end") is being carried out, where the sections specified in the atlas project are indicated and for which the sections are allocated.



**Figure 4.** Overview and sections of horticulture and viticulture web Atlas

According to our preliminary calculations, the atlas consists of the following four sections, namely, the first section-maps of the natural and socio-economic conditions of horticulture and viticulture; the second section-maps that give a general description of horticulture and viticulture; the third section-maps of the network of horticulture and viticulture; the fourth section-maps of horticulture and viticulture of its regional characteristics.



**Figure 5.** Sections of the Atlas of gardening and viticulture web

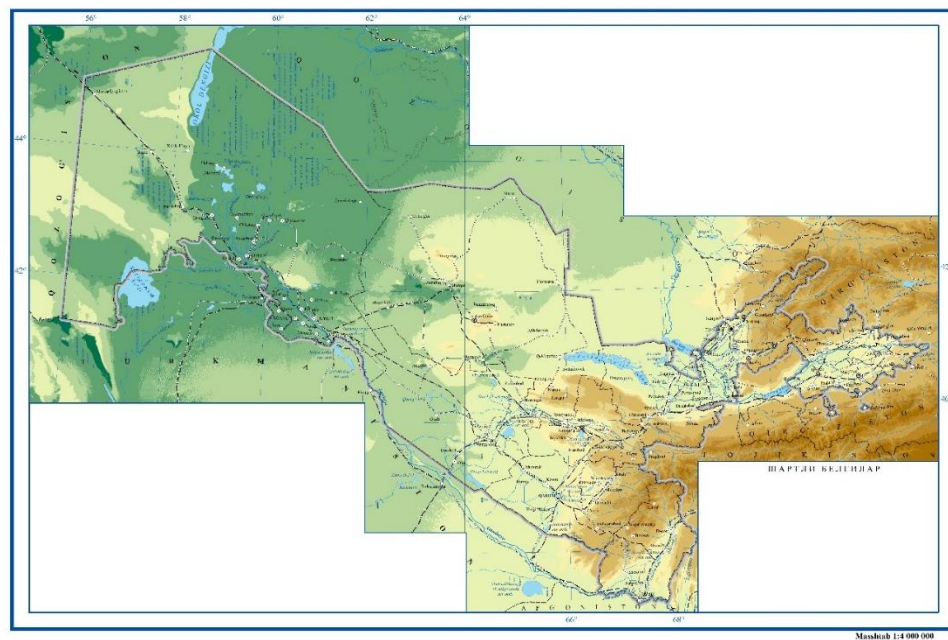
The above section and its maps are based on the GIS application ArcGIS 10.6, and the database is formatted in ArcCatalog 10.6, and their creation continues. Accordingly, now the model component of the natural map of the Republic of Uzbekistan on a 1: 4 000 000 scales has been developed. When compiling maps, RGB (Red, Green, Blue) colors were selected according to the color model. All of the



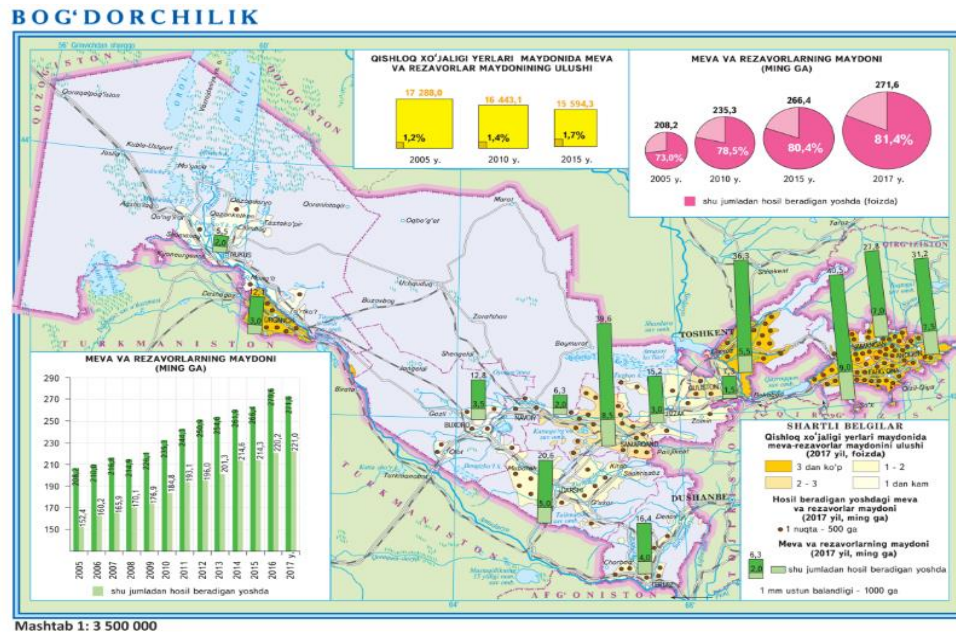
colors logically represent the position of the place (the structure of the Landschaft) in connection with each other.

The layout component of all the maps included in the Atlas has become ready and based on Shular, a series of thematic maps is now being drawn up. An example of this is the horticultural map of Uzbekistan. This map is made ready and can be used. The map is structured on a 1:3 500 000 scale, in which the degrees (levels) nets are indicated.

In the main content of the map, the share of the area of fruits and berries in the field of agricultural land is given in percentage terms. In addition, the area of fruits and berries at the age of harvest points per thousand hectares, as well as the method of car



**Figure 6.** Model layout of the natural map of the Republic of Uzbekistan at a scale of 1: 4,000,000



**Figure 7.** Horticultural map of the Republic of Uzbekistan

### Discussion

Currently, in the creation and use of cartographic products, in addition to traditional cartographic methods, methods of processing and mapping data on a computer is increasingly used. At the same time, one of the most important areas of the development of Computer Technologies is web technology, which opens the possibility of access to any information in the whole world – all users who have access to the Internet [18, 10, 12, 15, 26, 8, 3].

An important stage in the development of cartographic web products is their methodological development, which consists of solving several design problems. When choosing a color scheme when creating an atlas, color models, and color scheme, it is important to remember that the result of this research is a web product. The color design of the atlas determines the broad functionality of the program, which allows the user to change the color of the interface to his liking. In addition, the addition of cartographic, textual, photographic materials is carried out by administrators based on a special profile.

Special thematic sections of the web atlas have been developed, which will be delivered to users only after initial testing and verification of the work on the Internet. The structure of the web atlas is based on the principle of modularity, which allows you to change individual blocks that can be filled in or expanded without changing the structure of the entire system.

The main differences between a web atlas and a traditional atlas are as follows:

- Atlas structure;



- change the format depending on the user's capabilities;
- can be used on mobile and computer devices;
- Possibility of automatic analysis;
- the amount of information;
- automated search engine;
- access to multimedia;
- interface.

Accordingly, modern web atlases perform several functions, such as hosting existing cartographic materials in a web environment based on a database or metadata generated from GIS technologies, which allows users to integrate preprocessed data and its data with existing services. The web atlas on horticulture and viticulture includes socio-economic and natural conditions, general descriptions of horticulture and viticulture, network maps of horticulture and viticulture, and maps showing their regional characteristics using cartographic methods [15]. It should be noted that until now fully scientifically grounded cartographic works on this topic have not been created. Now, with the integration of modern technology and software, this platform, available to everyone, allows viewing in 3 languages simultaneously and, most importantly, publishing the necessary parts in different formats, determines how quickly cartography progresses.

Although the soil and climatic conditions of Uzbekistan are different in each region, it is possible to grow high-quality fruits, grapes, and crops only if they comply with the rules of agricultural technology developed on a scientific basis. [11].

## Conclusions

Erasmus+ “DSinGIS –Doctoral study in Geoinformatics” project has been giving good opportunity for researchers of Uzbekistan in case of organizing 2 months scientific and practical training courses to improve their knowledge and skills in Geoinformatics and remote sensing.

I had achieved crucial knowledge and skills during two months. In the future, I will more develop my knowledge on application of Remote Sensing and GIS.

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