TASHKENT INSTITUTE OF IRRIGATION AND AGRICULTURAL MECHANIZATION ENGINEERS

REPORT

on study visit to Obuda University of Hungary in the frame of the Erasmus+ DSinGIS project

(January 03– March 03, 2019)

PhD student: Mr. Mamanbek Reimov

Mentor: Dr. Malgorzata Verőné Wojtaszek

Topic: *"Study ecosystems and its services of Aral Sea region on the basis of GIS technologies to create a network of protected natural areas in Uzbekistan"*.

TASHKENT, 2019

Content

- Introduction
- Study Plan
- Time table
- Activities
- Outputs of the stay
- Conclusion and future plans
- Acknowledgments
- References

Introduction

A **geographic information system** (**GIS**) is a system designed to capture, store, manipulate, analyze, manage, and present spatial or geographic data. GIS applications are tools that allow users to create interactive queries (user-created searches), analyze spatial information, edit data in maps, and present the results of all these operations. GIS can refer to a number of different technologies, processes, techniques and methods.

The wider aim of the project is to support Uzbekistan in sustainable development by GISc. The objectives envisaged with the project is to establish a missing puzzle from the Uzbek educational system after the MSc level has been completed and before the DSc is targeted. The proposal offers a programme and methods to bridge the gap.

One of the main aim of DSinGIS project is to ***enhance the scientific level of academic and research staff at UZ partner universities in the field of GISc***.

Taking into account the one of the aim of the project, DSinGIS had a call for young researcher mobility in short term period at partner universities. Current PhD student Mamanbek Reimov from Tashkent Institute of Irrigation and Agricultural Mechanization Engineers, Uzbekistan successfully admitted and shortlisted from the first call of the mobility and had opportunity two-month research-visit from January-February 2019 at Obuda University, Hungary. During this period of stay he continued his PhD research under the supervision of Dr. Malgorzata Wojtaszek in the sphere of remote sensing and GIS on the research topic ***"Study ecosystems and its services of Aral Sea region on the basis of GIS technologies to create a network of protected natural areas in Uzbekistan"***.

During the two-month stay I had a great chance to be familiarize with new Remote Sensing analysis such as Land classification, Land use mapping, supervised/unsupervised and segment based classifications and image tools. There were several research site visits organized by Dr. Valeria Balazsik in order to compare the field with Landsat and Sentinel images. Furthermore, with recommendation and near assistance of Prof. Bela Markus there were meeting was organized with Dr.Takács András Attila and got necessary information about current condition of nature protected areas in Hungary. Moreover, during the stay at Obuda together with

Dr.Lorant Foldvary applied for the next call project Erasmus+ International Credit Mobility project in January 2019.

"Nowadays majority nature protected areas and biosphere reserves at the Lower part of Amudarya River are on the verge of disaster. This primarily is due to two main issues. First, increase of water scarcity in the lower part of Amudarya River, which leads to termination of tugai forests and biodiversity, increase of desertification and salinity of the territory. The second huge negative impact comes from human activities: farming and production of building materials, which leads to degradation of the soil and landscape of the reserve. The key point of these problems is that even though the Lower Amudarya State Biosphere Reserve and Complex (landscape) Reserve "SAYGACHI" were established to protect the unique tugai environment, but nowadays it is not able to fulfill these functions because of the absence of effective control. Quantification, mapping and remote sensing analyses of ecosystem services are going to construct a base for the control over the existing services by identifying where high level of services need protection or management in order to reduce the negative impact on the ecosystem of the Lower Amudarya State Biosphere reserve and Complex (landscape) Reserve "SAYGACHI" in Uzbekistan" and now I am working on the scientific article in annual GI conference".

Study Plan

Before the study visit to Obuda University of Hungary, Study plan had been applied with requested documents. Here, below study plan is given:

- Introducing my Supervisor from Host Institute;
- Taking tasks and assignments from my Host Institute Supervisor;
- Reviewing the scientific papers and articles, which are related to:
- Application of Remote Sensing and GIS in precision agriculture;
- GIS methods for land use optimization in irrigated agriculture area with ecological constraints.
- Learning new applied remote sensing methods and GIS programs.
- Going to library and learning new scientific books which are regarding to my field of study;
- Learning how to write scientific papers in my research;
- Participating to International scientific conferences or Workshops (if applicable);

Activities and Outputs of the stay

During the two months study visit to Obuda University, I have strengthened my scientific and practical knowledge on Remote Sensing and GIS. Firstly, basic concept of remote sensing, pixel and segment based classification, basic algorithms of image processing were taught by Dr Wojtaszek Malgorzata.

Moreover, under supervision of Dr. Wojtaszek Malgorzata important Remote sensing methods and tasks such as: image geometric correlation, atmospheric correlation, assessing quality of the satellite images, classifying types of Agricultural crops through segments or training areas, monitoring of land cover changes by using supervised and unsupervised methods by using Sentinel 2 and Landsat 8 satellite images (Figure 1).

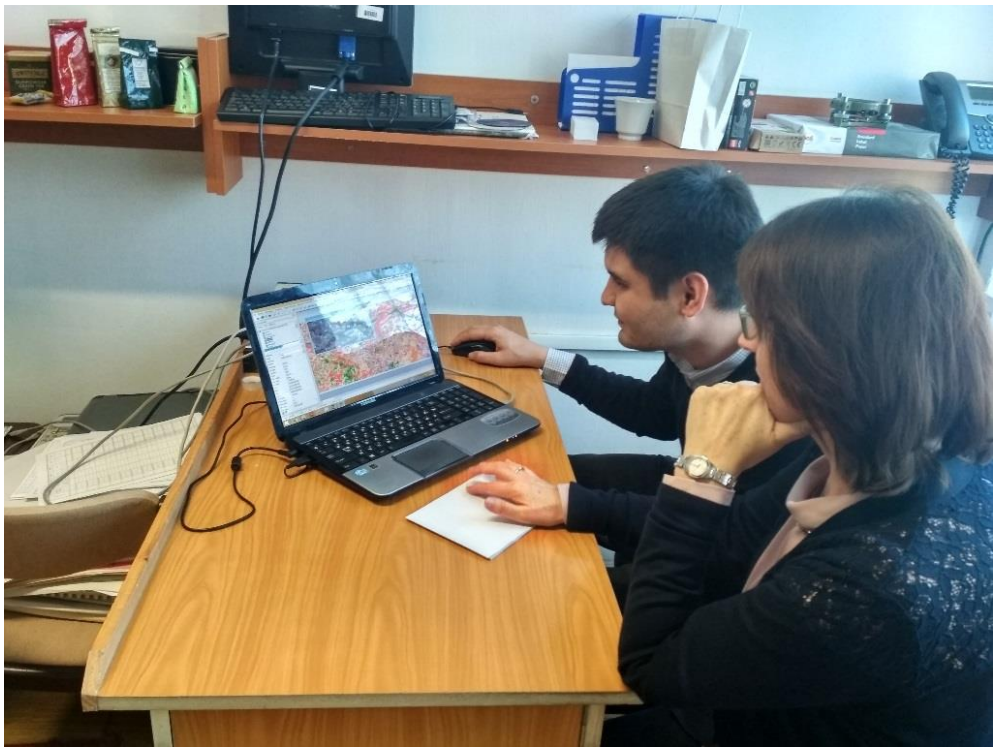


Fig. 1. Scientific research with Dr. Wojtaszek Malgorza on classifying agricultural crop types by using Remote Sensing methods

In addition, some new software's for implementing remote sensing tasks as IDRISI Selva (Figure 2) and eCognition Developer software's opportunities have been learned and have done some analyses with them on classifying agricultural crop types (Figure 3).

Before classifying crop types, process starts with land use/land cover classification.

Land cover is fundamental, because in many existing classifications and legends it is confused with land use: Land cover is the observed (bio)physical cover on the earth's surface [3].

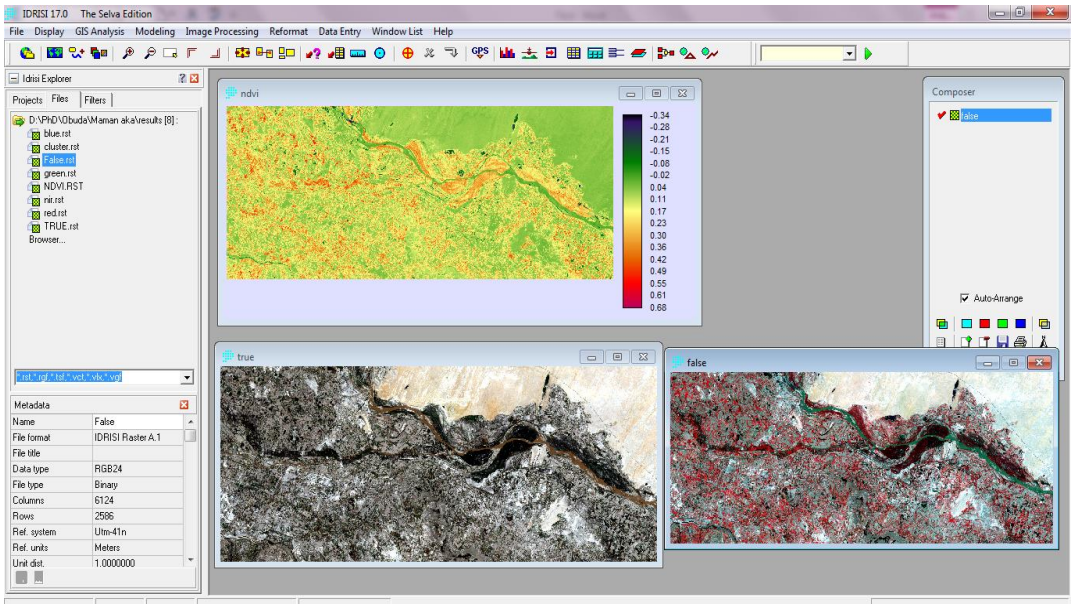
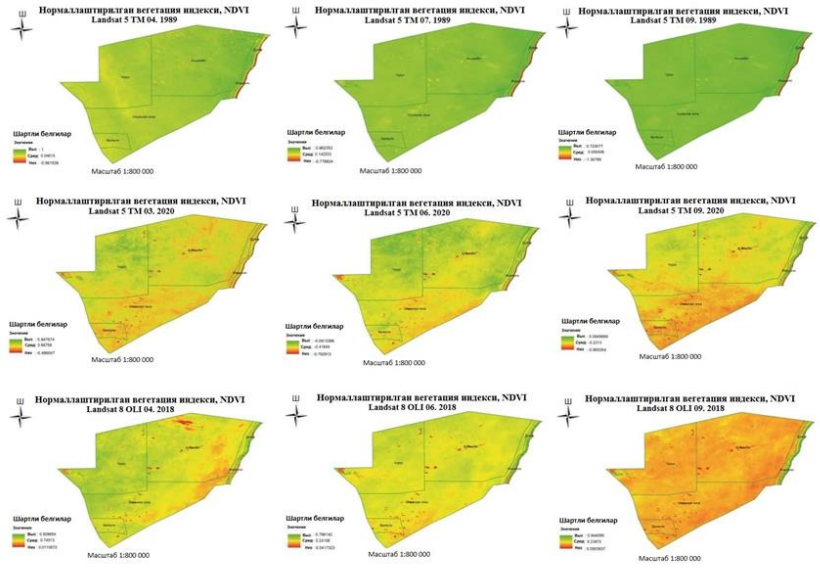


Fig. 2. NDVI, true color, and false color analyses with Selva IDRISI

Land use is characterized by the arrangements, activities and inputs people undertake in a certain land cover type to produce, change or maintain it. Definition of land use in this way establishes a direct link between land cover and the actions of people in their environment.



8 - расм. Нормаллаштирилган вегетацион индекс, NDVI («Сайгачий» мажмуа (ландшафт) буюртма қўриқхонаси 1989й; 2000й; 2018 й.)

Fig.3. Creating land cover classification of protected area Saygachiy of Uzbekistan using by eCognation Developer

A classification describes the systematic framework with the names of the classes and the criteria used to distinguish them, and the relationship between classes.

Classification thus requires the definition of class boundaries, which should be clear, precise, possibly quantitative, and based upon objective criteria.

Land use/land cover (LULC) classification is one of the most important applications in remote sensing, but is a complex procedure, because different factors, such as the spatial

resolution of the remotely sensed data, availability of different data sources (e.g., field survey data, digital elevation model data), a suitable LULC classification system, availability of classification software, and the analyst's experience may affect the classification results.

Classification algorithm should be used for a specific dataset in a study area remained to be answered, although many classification methods, from traditional parametric algorithms such as maximum likelihood classifier (MLC), to advanced nonparametric algorithms such as artificial neural network (ANN),decision tree, and support vector machine (SVM) are available. Another challenge is to select a proper dataset for LULC classification. However, different kinds of sensor data have various characteristics in spatial, spectral, radiometric, and temporal resolutions, as well as different angles and polarizations for radar data. It is important to effectively incorporate different data features into a classification procedure for improving LULC classification accuracies.

There are two major categories of image classification techniques include unsupervised (calculated by software) and supervised (human-guided) classification.

Unsupervised classification is where the outcomes (groupings of pixels with common characteristics) are based on the software analysis of an image without the user providing sample classes. The computer uses techniques to determine which pixels are related and groups them into classes (Figure 4).

Mostly for unsupervised classification Minimum distance, Maximum Likelihoods and IsoCluster methods were used.

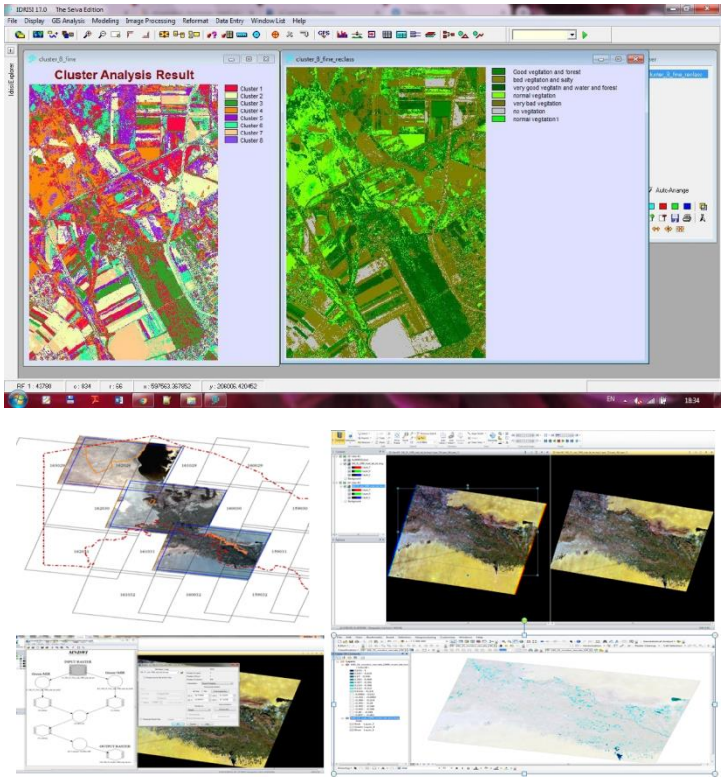


Fig. 4. Unsupervised classification of subset area with Idrisi Selva

Supervised classification is based on the idea that a user can select sample pixels in an image that are representative of specific classes and then direct the image processing software to use these training sites as references for the classification of all other pixels in the image. Training sites (also known as testing sets or input classes) are selected based on the knowledge of the user. The user also sets the bounds for how similar other pixels must be to group them together (Figure 5).

These bounds are often set based on the spectral characteristics of the training area, plus or minus a certain increment (often based on "brightness" or strength of reflection in specific spectral bands). The user also designates the number of classes that the image is classified into. Many analysts use a combination of supervised and unsupervised classification processes to develop final output analysis and classified maps.

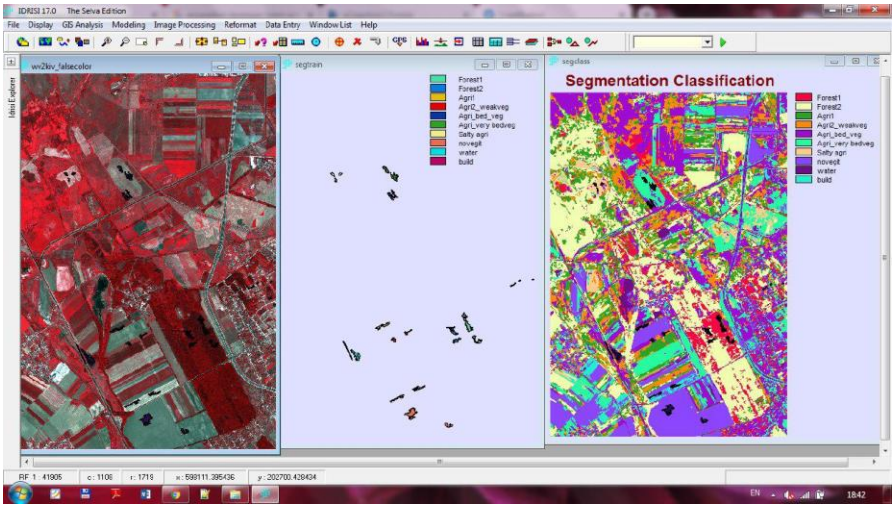
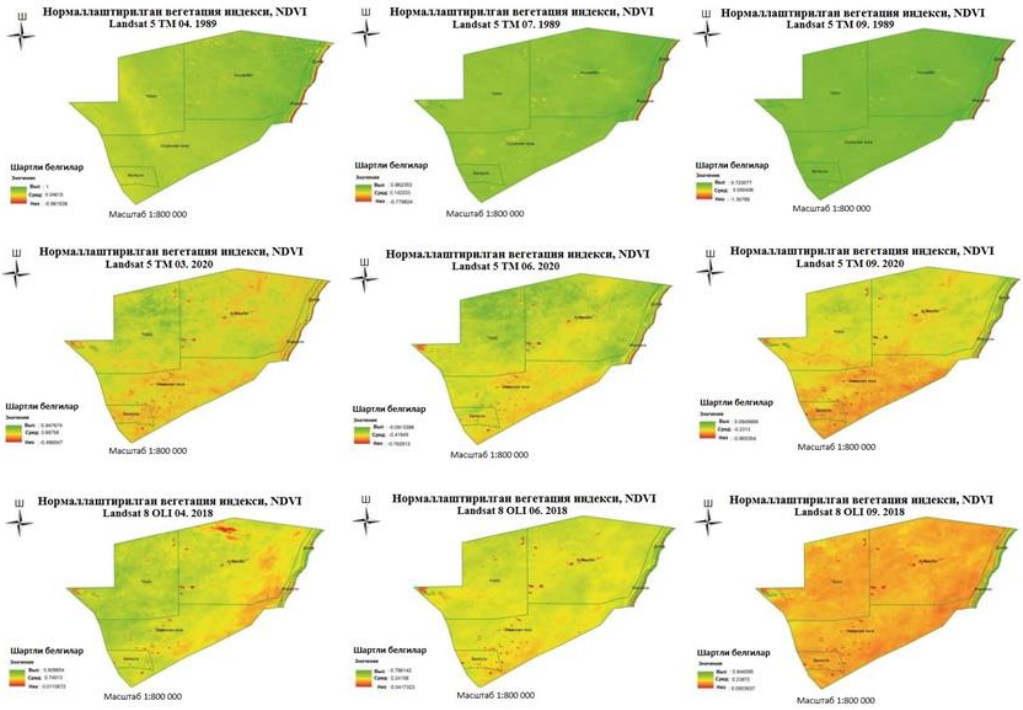


Fig. 5. Supervised classification process with Idrisi Selva

Laboratory and field works results compared and created land use and cover maps (Figure 6).

Fig.6. Field research for getting actual data for crop type maps

At the end of the research, for evaluating supervised classification results Accuracy Assessment analyse had done.



8 - расм. Нормаллаштирилган вегетацион индекс, NDVI («Сайгачий» мажмуа (ландшафт) буюртма қўриқхонаси 1989й; 2000й; 2018 й.)

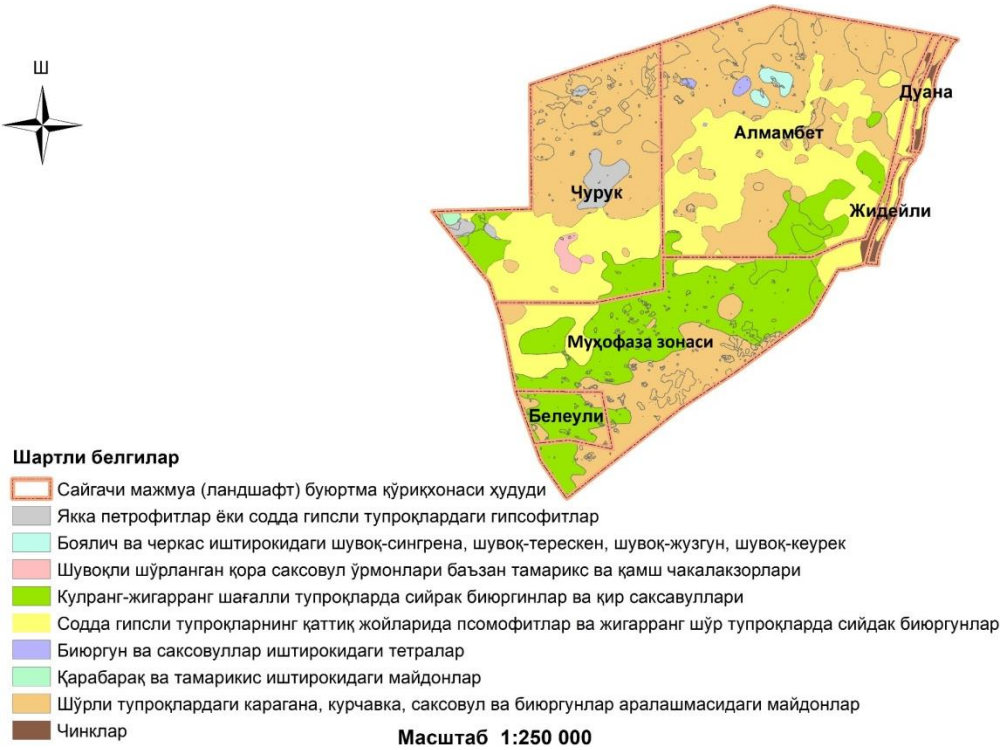


Fig.7. Study area classification maps

With a help of gotten knowledge from Obuda University, two articles were published. One of them published in Conference Proceeding of TIIAME and the second one was published in International Journal.

Fig.8. Group photo after fruitable meeting with authority of Obuda University

Moreover, there were meeting was organized with vice rectors of TIIAME and Obuda University on March 1st, 2019. From TIIAME side Prof. Bakhadir Mirzaev vice rector of academic affairs, Dr. Narbaev Sharafatdin, dean of Faculty of Land Resources Management, Ilhom Abdurahmanov, head of International Department, Zokhid Mamatkulov, PhD student of the DSinGIS project and I participated. There were discussed to organize trainings for staff and MSc students in sphere of "Smart Agriculture", "Geoinformatics", "Land Management" and "Mechatronics" in framework of joint program between the Tashkent Institute of Irrigation and Agricultural Mechanization Engineers and Obuda University (Figure 8, 9).

Fig.9. The processes of getting acquainted with sphere based literatures and certificate submission of course completion

During two months period, I have read many sphere based literatures and analyzed lots of article sources related to my dissertation topic at Information Resource Centre of Alba Regia Technical Faculty of Obuda University. At the end of the 2 months study visit at Obuda University, I have awarded completion of certificate (Figure 9).

Conclusions and future plans

Erasmus+ "DSinGIS –Doctoral study in Geoinformatics" project has been giving good opportunity for doctoral students and young 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.

So far, several young researchers and doctoral students from partner HEIs of Uzbekistan have been and improved their skills and qualification in their research topic and field of studies at European partner universities. Among them, I had a great chance to visit to one of the highly ranked Alba Regia Technical faculty of Obuda University in Szekesfehervar, Hungary.

I had achieved very important and crucial knowledge on my dissertation topic during two months. In the future, I will more develop my knowledge on application of RS and GIS in agriculture.

Acknowledgements

I gratefully acknowledge for great opportunity and financial support by Erasmus + "DSinGIS – Doctoral Studies in Geoinformatics" project, DSinGIS project coordinators Dr Lorant Foldvary, professor Markus Bela, Ilhom Abdurahmanov, project PhD student – Zokhid Mamatkulov, Supervisor from Obuda University - Dr. Wojtaszek Malgorza, Dr.Balázsik Valéria and international relations department of TIIAME for technical support before and during my study visit in Szekesfehervar, Hungary.

References

1. http://geoinformatics.uz/
2. http://www.dsingis.eu
3. http://www.fao.org/3/x0596e/x0596e01e.htm
4. D. Lu and Q. Weng, "A survey of image classification methods and techniques for improving classification performance". International Journal of Remote Sensing, 28(5): 823 – 870, March 2007.
5. https://mapasyst.extension.org
6. https://www.e-education.psu.edu/geog883/node/524
7. http://www.amk.uni-obuda.hu
8. http://news.uni-obuda.hu/en/articles/2019/03/06/visit-of-the-tashkent-institute-of-irrigation-and-agricultural-mechanization-eng