Research Journal of Agricultural Science, 43 (3), 2011

POSSIBLE EVALUATION AND MONITORING OF AGRICULTURAL POTENTIAL ON BORDER AREAS

Carmen GRECEA, S. I. HERBAN, C. C. MUŞAT

"Politehnica" University of Timişoara,
E-mail: carmen.grecea@ct.upt.ro

Abstract*: The cross-border co-operation projects – as parts of the European territorial co-operation objective are implemented through operational programmes focusing on the European Union's internal borders, covering primarily the following areas:- The development of cross-border economic, social, environmental activities through joint strategies for sustainable territorial development; - Strengthening of transnational co-operation through actions related to Community priorities and promoting integrated territorial development; - Reinforcement of effectiveness of regional policy by promoting inter-regional cooperation, through exchange of experience at appropriate territorial level. The eligible border area for this possible programme covers the South-Eastern part of Hungary and the Western part of Romania, implying Csongrád County in Hungary and Timis County in Romania, exhibit fairly similar economic and social situation in general. The differences in the national regulations, funding mechanisms and rates hinder a more active co-operation in this field. Given that the potential exists, we consider it would be useful to implement a small scale project of pilot nature – for the beginning, which then could be mainstreamed and applied on a much wider basis. The area is rich in various natural values. With regard to the major economic sectors, agriculture and food industry play a key role in the economy of the entire area. As a result of the availability of a wide range of natural resources, the Romanian side of the area is characterized by a more diversified (and industrialized) economic structure. Geospatial Information related to efficient mathematical support can provide data at different spatial, spectral and temporal resolutions for agriculture and crop assessment, crop health, change detection, environment analysis, irrigated landscape mapping, yield determination and soils analysis. Once data has been collected it can be implemented into a mapping environment such as GIS (Geographic Information Systems) for management and control of agricultural resources. Imagery acquired by airborne or satellite sensors provides an important source of information for mapping and monitoring the natural and manmade features on the land surface.*

Key words: *border, satellite, sensor, remote sensing, spectral, geo-reference, euro-region, crop, vegetation, map, sustainable development*

INTRODUCTION

Such programme strategy aims to bring different actors – people, economic factors and communities – closer to each other, in order to better exploit the opportunities offered by the joint development of the border area. The elaboration of the programme involves regular consultations with a wide range of local and sectorial partners, providing them with the opportunity to contribute to the programming process.

As part of this consultation process, various workshops have be delivered during the programme area.

Among others, the following key institutions in both countries are to be involved in the consultations:

- County councils, County governments, County development agencies
- Major towns
- Universities, colleges
- Regional development agencies

- Chambers of commerce
- Euroregions
- Water management authorities

The total area of the Hungarian side is part of the **Hungarian Great Plain**, while the Romanian area includes the **Romanian Western Plain.**

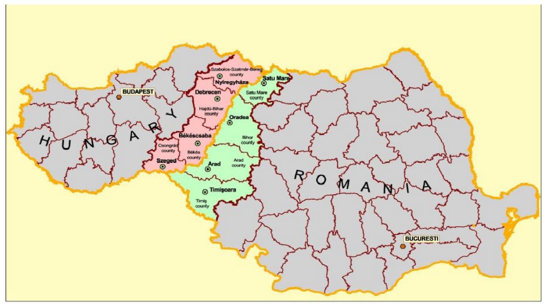


Figure 1: The programme area

MATERIAL AND METHODS

Agriculture resources are among the most important renewable, dynamic natural resources. The remote sensing techniques have been and it will continue to be a very important factor in the improvement of the present systems of acquiring and generating agricultural data.

Agriculture surveys are presently conducted throughout the world in order to gather information and statistics on crops, rangeland, livestock and other related agricultural resources. This information of data is most important for the implementation of effective management decisions. Agricultural survey is needed for planning and allocation of the limited resources to different sectors of the economy.

Geospatial Information related to efficient mathematical support can provide data at different spatial, spectral and temporal resolutions for agriculture and crop assessment, crop health, change detection, environment analysis, irrigated landscape mapping, yield determination and soils analysis. Scheduling and timing of image acquisition is very important and will hinge on the main goals and the type of information that the user is hoping to gain. Once data has been collected it can be implemented into a mapping environment such as GIS (Geographic Information Systems) for management and control of agricultural resources.

Imagery acquired by airborne or satellite sensors provides an important source of information for mapping and monitoring the natural and manmade features on the land surface. Interpretation and analysis of remotely sensed imagery requires an understanding of the processes that determine the relationships between the property the sensor actually measures and the surface properties we are interested in identifying and studying.

With increasing population pressure throughout the world and the need for increased agricultural production there is a definite need for improved management of the world's agricultural resources. To make this happen it is first necessary to obtain reliable data on not only the types, but also the quality, quantity and location of these resources. Satellite or Aerial Remote Sensing (RS) technology has been and always will continue to be a very important factor in the improvement of the present systems of acquiring and generating agricultural and resources data.

Vegetation Analysis

Vegetation images — show crop growth from planting through to harvest, changes as the season progresses and abnormalities such as weed patches, soil compaction, watering problems etc. A georeferenced and orthorectified image can locate these problem areas as well as the size of the area affected can be easily determined. This information can help the farmer make informed decisions about the most feasible solution. In addition to highlighting problematic areas, images will also help monitor the effectiveness of any corrective actions which may be implemented. Images can act as an early indicator of crop yield. This early predictor of yield can aid the farmer in making marketing decisions as well as the allocation of resources.

To gain the benefits from remotely sensed data farmers, managers, consultants and technicians must understand and be able to interpret the image. There are a wide range of enhancement tools available which can help make an image more interpretable for specific applications. Enhancement and classification tools are often used to highlight features. The techniques employed will depend on the type of remote sensed data as well as the objectives of the end user. Techniques commonly used include:

Change detection — or studying vegetation changes by subtracting one image from another image acquired at an earlier date.

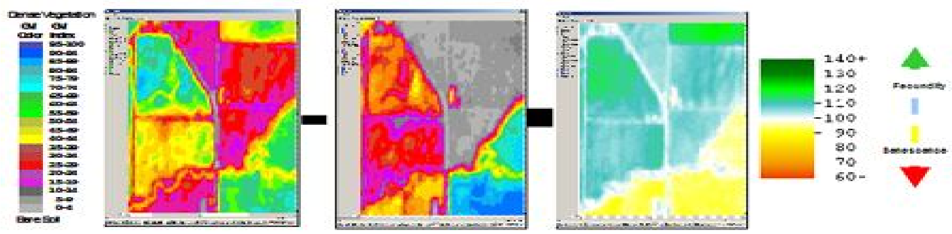
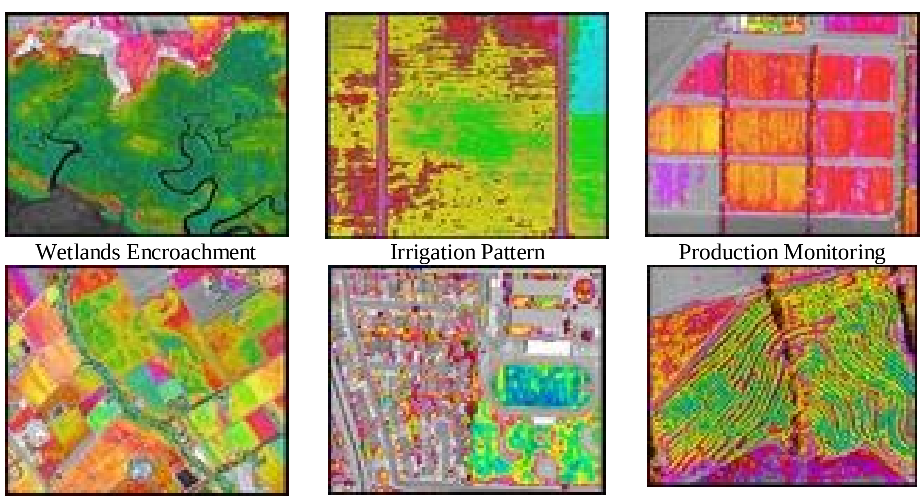


Figure 2: Exemple.for vegetation change detection (QuickBird — 2008 DigitalGlobe)

Classifications — where the pixels of an image are sorted into classes and each class is given a unique color defined by the spectral "signatures". A supervised classification requires knowledge of the data as the analyst selects pixels that correspond to known features (such as differences in the land cover).



Wetlands Encroachment | Irrigation Pattern | Production Monitoring

Crop Health Variations | Urban Forest and Turf | Soils and Fertility Analysis

Figure 3: Vegetation Indices (QuickBird — 2008 DigitalGlobe)

Vegetation Indices — Using the distinct spectral signature of plants with low reflectance in the visible (0.4-0.7 um) and very high reflectance in the near infrared region (0.7-1.2 um) of the solar spectrum, the spectral contrast can be used for identifying the presence of green vegetation and evaluating some characteristics through various vegetation indices.

Vegetation Response to Irrigation

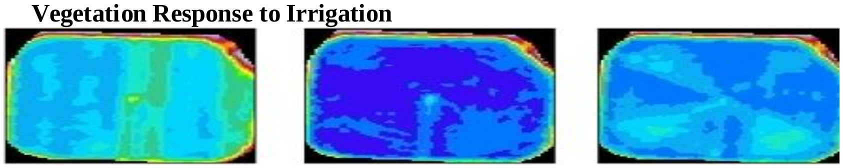


Figure 4: Irrigation Spectra (QuickBird — 2008 DigitalGlobe)

Temporal Resolution

The surface environment of the Earth is dynamic, with change occurring on time scales ranging from seconds to decades or longer. The seasonal cycle of plant growth that affects both natural ecosystems and crops is an important example. Repeat imagery of the same area through the growing season adds to our ability to recognize and distinguish plant or crop types. A time-series of images can also be used to monitor changes in surface features due to other natural processes or human activity. The time-interval separating successive images in such a series can be considered to define the *temporal resolution* of the image sequence.

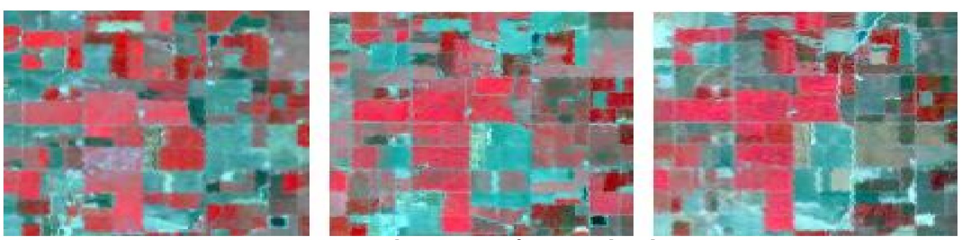


Figure 5: Landsat images of an agricultural area

This sequence of Landsat images of an agricultural area was acquired during a single growing season: April (left), 30 June (center), and October (right).

In this band combination vegetation appears red and bare soil in shades of blue-green. Some fields show an increase in crop canopy cover from April to June, and some were harvested prior to October.

RESULTS AND DISCUSSIONS

A. Spatial Registration and Normalization

We can make qualitative interpretations from an image time-sequence (or images from different sensors) by simple visual comparison. If we wish to combine information from the different dates in a color composite display, or to perform a quantitative analysis such as spectral classification, first we need to ensure that the images are spatially registered and spectrally normalized.

Spatial registration means that corresponding cells in the different images are correctly identified, matched in size, and sample the same areas on the ground. Registering a set of images requires several steps. The first step is usually *georeferencing* the images: identifying in each image a set of control points with known map coordinates.

The control point coordinates can come from another georeferenced image or map, or from a set of positions collected in the field using a Global Positioning System (GPS) receiver. Control points are assigned in TNTmaps in the Georeference process (Edit/Georeference). We can find step-by-step instructions on using the Georeference process in the tutorial booklet entitled *Georeferencing*.

After all of the images have been geo-referenced, we can use the Automatic Resampling process (Process / Raster / Resample / Automatic) to reproject each image to a common map coordinate system and cell size.

B. Fusing Data from Different Sensors

Materials commonly found at the Earth's surface, such as soil, rocks, water, vegetation, and man-made features, possess many distinct physical properties that control their interactions with electromagnetic radiation.. Because the interactions of EM radiation with surface features in spectral regions are different, each of the corresponding sensor systems measures a different set of physical properties. Although each type of system by itself can reveal a wealth of information about the identity and condition of surface materials, we can learn even more by combining image data from different sensors. Interpretation of the merged data set can employ rigorous quantitative analysis, or more qualitative visual analysis.

The image below show a small area (about 1.5 by 1.5 km) of cropland. This hyperspectral sensor acquires images in numerous narrow spectral bands in the visible to middle infrared range. The band combination to the right uses bands from the near infrared, green, and blue wavelength regions to simulate a color infrared image; red indicates vegetated areas, in this case fields with full crop canopy.

The brightest radar returns come from crops with a tall, bushy structure. The brightest field in the center is a broccoli field, and a vineyard with vines trained to a vertical trellis is at bottom center.

Colors in the combined image differentiate fields by degree of plant cover (red hue) and plant structure (intensity).

Figure 6: Spectral bands

Four image areas are shown below to illustrate useful color combinations of bands in the visible to middle infrared range.

Ex: Healthy green vegetation appears bright green. Yellowed grass and typical agricultural soils appear pink to magenta. Deeper water is black. Rock materials typically appear in shades of brown, gray, pink, and red.

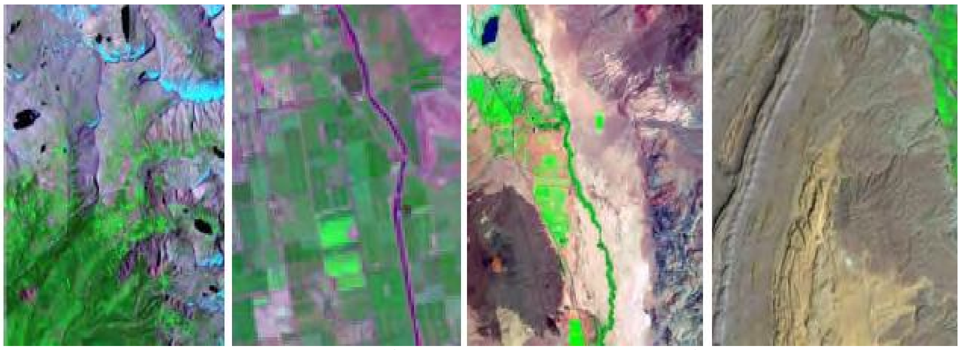


Figure 7: Combinations of bands in the visible to middle infrared range

CONCLUSIONS

The differences in the national regulations, funding mechanisms and rates hinder a more active co-operation in this field. Given that the potential exists, we consider it would be useful to implement a small scale project of pilot nature – for the beginning, which then could be mainstreamed and applied on a much wider basis.

The area is rich in various natural values. With regard to the major economic sectors, agriculture and food industry play a key role in the economy of the entire area. As a result of the availability of a wide range of natural resources, the Romanian side of the area is characterized by a more diversified (and industrialized) economic structure.

The programme strategy aims to bring different actors – people, economic factors and communities – closer to each other, in order to better exploit the opportunities offered by the joint development of the border area.

Agriculture resources are among the most important renewable, dynamic natural resources. The remote sensing techniques have been and it will continue to be a very important factor in the improvement of the present systems of acquiring and generating agricultural data.

Agriculture surveys are presently conducted throughout the world in order to gather information and statistics on crops, rangeland, livestock and other related agricultural resources. This information of data is most important for the implementation of effective management decisions. Agricultural survey is needed for planning and allocation of the limited resources to different sectors of the economy.

ACKNOWLEDGMENT

1)"This work was partially supported by the strategic grant POSDRU/21/1.5/G/13798, inside POSDRU Romania 2007-2013, co-financed by the European Social Fund - Investing in People".

BIBLIOGRAFY

1. HERBEI O., HERBEI M., 2010 – Sisteme Informatice Geografice, Ed. Universitas
2. ȚĂRĂU D., 2003 – Bazele teoretice şi practice ale bonitării şi evaluării terenurilor din perspectiva pedologică, Ed.Solness, Timişoara
3. BĂDUȚ M., 2004 – GIS, Sisteme informatice geografice – Fundamente Practice, Ed. Albastră, Cluj Napoca
4. GRECEA C., 2007 – Cadastral Systems, new trends and experiences, Journal of geodesy and Cadastre, RevCAD nr.7, Ed. Aeternitas Alba Iulia
5. GRECEA C., 2005 – Geodezie, Ed.Mirton, Timişoara

6. GRECEA C., 2009 – Impact of surveying engineering on the environmental protection problems, BENA Conference, Istanbul
7. ***The Geo-Positioning Selection Guide for Resource Management, Technical Note 389, USA
8. ***Geo Info. Systems, Aster Publishing, Marion, OH
9. ***GIS World
10. www.satimagingcorp.com/svc/agriculture.html
11. http://www.isprs.org
12. http://www.waset.org/journals/waset/v71/v71-17.pdf
13. www.digitalglobe.com