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Reserach Article

Determination of Paddy Rice Parcels from RGB Satellite Images Using Image Processing Techniques

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Abstract

The remote sensing technique is of great importance in agriculture in determining vegetation cover, monitoring its development, classification, and yield estimation. Various sofwares, mathematical algorithms, and statistical approaches are used to make satellite images meaningful in remote sensing. In this study, it is aimed to determine the rice plant plots and areas by using the Augelab Studio sofware, which is a new approach in artificial intelligence-supported image processing techniques. Using the RGB image covering an area of 2.5 km^2 obtained from Google Earth Pro, the classification of paddy rice fields and the calculation of these areas were made. Rice fields from parcels with different plant patterns were separated using Augelab Studio artificial intelligence image processing software using filtering blocks. The real areas of the other rice parcels were determined by the coefficient created by taking the pixel area values of some of the parcels whose total area is known as a reference. It is found that total areas of rice parcels in Augelab Studio and Google Earth Pro programs to be 79.8 and 80.1 hectares, respectively. It has been observed that the areas of the paddy rice parcels can be determined with high accuracy by using Augelab Studio.
Keywords: Image processing, Augelab studio, Remote sensing, Vegetation classification

RGB Uydu Görüntülerinden Çeltik Parsellerinin Görüntü İşleme Teknikleri Kullanılarak Belirlenmesi

Öz

Uzaktan algılama tekniği tarımda, bitki örtüsünün belirlenmesi, gelişiminin izlenmesi, sınıflandırılması ve verim tahminlerinin yapılmasında büyük önem taşımaktadır. Uzaktan algılamada uydu görüntülerini anlamlı hale getirebilmek için çeşitli yazılımlar, farklı matematiksel algoritmalar ve istatistiksel yaklaşımlar kullanılmaktadır. Bu çalışmada, yapay zekâ destekli görüntü işleme tekniğinde yeni bir yaklaşım olan Augelab Studio programı kullanılarak çeltik bitkisi parselleri ve alanlarının belirlenmesi amaçlanmıştır. Google Earth Pro'dan alınan 2.5 km^2'lik alanı kaplayan RGB görüntü kullanılarak çeltik alanlarının sınıflandırılması ve bu alanların hesabı yapılmıştır. Farklı bitki desenine sahip parsellerden çeltik ekili alanlar Augelab Studio yapay zekâ görüntü işleme yazılımı kullanılarak filtreleme blokları kullanılarak ayrılmıştır. Gerçek alanı bilinen parsellerden bazılarının piksel alanı değerleri referans alınarak oluşturulan katsayı ile diğer çeltik parsellerinin gerçek alanları tespit edilmiştir. Çalışma sonucunda, Augelab Studio ve Google Earth Pro programlarında çeltik parsellerinin toplam alanları sırasıyla 79.8 ha ve 80.1 ha olarak bulunmuştur. Augelab Studio kullanılarak çeltik parsellerine ait alanların yüksek doğrulukta belirlenebildiği görülmüştür.
Anahtar Kelimeler: Görüntü işleme, Augelab Studio, Uzaktan algılama, Bitki örtüsü sınıflandırılması

Introduction

The rapidly increasing world population puts many pressures on agricultural sector. It has become inevitable to use technology at the highest level to ensure the sustainability of agricultural production, increase yield, adapt to climate change, and reduce the labor requiremenst (Zhai et al., 2020).

Remote sensing is the technique of detecting and monitoring the physical properties of an area by detecting the radiation reflected and emitted from an area from a certain distance through sensors placed on satellites, aircraft, or human aircraft and processing the obtained data. Today, all branches of science dealing with the earth use remote sensing (Caf, 2019). In the research, it has been determined that the use of satellite images in land cover determination studies provides ease of management in agricultural production. With the increase in the terrestrial resolution of satellite data, earth objects are displayed with more pixels and presented to users in more detail (Ersan and Başyiğit, 2017). Remote sensing and geographic information systems are accepted as ideal tools used to provide the data and environment necessary for the determination and analysis of changes in land cover and use classes (Berberoğlu, 2003). One of the most important image processing techniques in remote sensing science is classification. Multiband image classification is one of the most used methods to obtain thematic information from remote sensing images (Özçalık et al., 2020).

Image processing is a computer-based technique used to extract meaningful results by processing measured or recorded electronic image data in a digital environment by the purpose. Today, it is used effectively in military, security, criminal analysis, robotics, traffic, newspaper, and mapping applications. The fact that the application produces fast and successful results at a low cost and is also suitable for automation is one of the remarkable features of image processing techniques (Ağın and Malaslı, 2016).

The image processing technique has an important role in agricultural production. Using this technique, the characteristics of the pixels that make up the image are determined and classified (Kavzoğlu and Çölkesen, 2010; Özçalık et al., 2020).Guijarro et al., (2011) used image processing techniques in their study for the classification of existing vegetation. First of all, researchers applying normalization in the existing color scale used the differences in the gray level corresponding to these parts in distinguishing the green parts from other areas. Thus, they successfully differentiated maize, barley, and perennial plants.Çetin et al., (2022) performed the counting of seeds belonging to two different plants, which are mixed in different numbers on a single image with machine learning methods in the Augelab Studio program, with 100% accuracy. In addition, they performed the classification with an accuracy rate of 96% to 100%.Shelestov et al., (2017) used images taken from the Landsat-8 satellite in their study in an area in Kyiv, Ukraine, using Google Earth Engine. As a result of processing the images, they classified 13 different products and reached 76.9% accuracy with the classification and regression tree (CART), which is one of the machine learning methods.This study aims to determine rice parcels and areas using Augelab Studio, an artificial intelligence-supported image processing software, which does not require any coding and is based on the principle of connecting function blocks using the drag and drop technique.

Material and Method

StudyArea

The study was carried out on 298 parcels located in a total area of 2.5 km^2 within the borders of Yenice village (40°40'51"N, 26°08'21"E) in Edirne province, Enez district (Figure 1). The number of parcels in question was determined from the parcel inquiry application of the General Directorate of Land Registry and Cadastre.

Edirne province alone meets more than 40% of the rice production in Türkiye (TUIK, 2020; TEPGE, 2020). Enez, İpsala, Keşan, and Uzunköprü districts in the Meriç and Ergene Stream valleys are the places where the most intensive rice farming is conducted (Taşlıgil and Şahin, 2011).

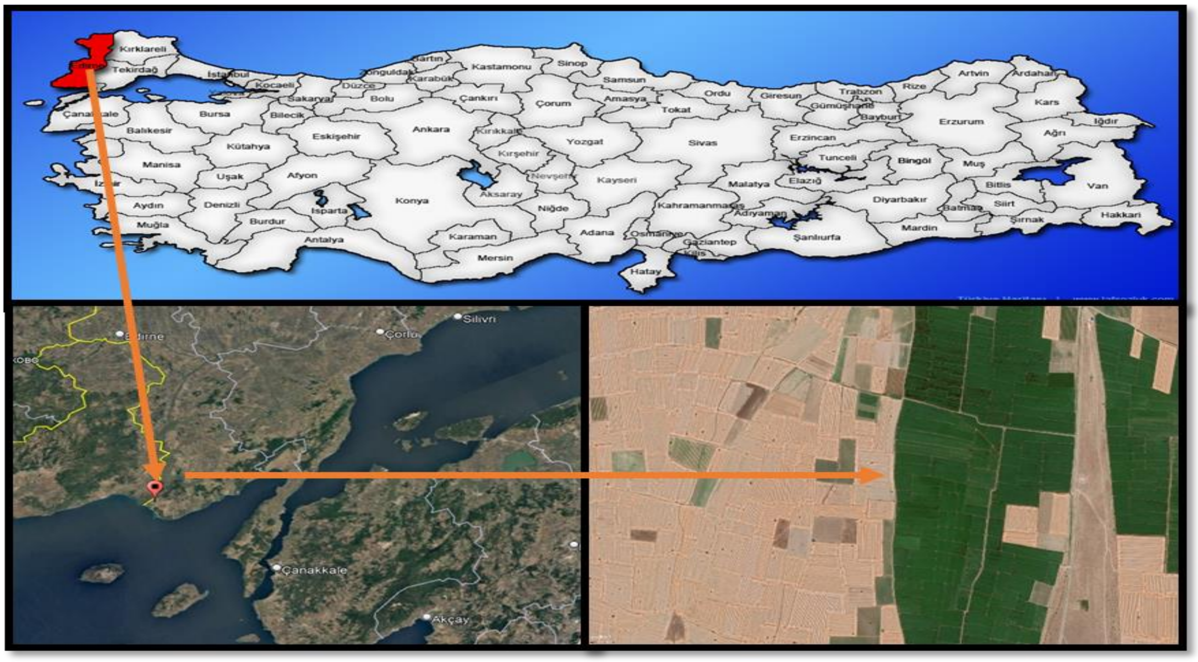

Figure 1. Project area

Satellite Data and Software

The image dated 10/07/2019, which covers the vegetation period and is the least cloudy, was obtained from the Google Earth Pro in JPEG format as an RGB image containing different plant plots (wheat stubble, sunflower, bush, clover, apple orchard, pear orchard, pasture). This image was processed in Augelab Studio, necessary classifications were made and rice cultivated areas were calculated. This software enables the development of purpose-specific image processing and artificial intelligence control systems quickly and easily without the need for coding knowledge.

In Augelab Studio, complex library and coding tasks are integrated into ready-made function blocks. Therefore, knowing the logical sequence of operations to be performed during image processing is enough to perform analysis. When the function required for each operation is connected with a flow chart logic, the programming operation is carried out. It is also possible to create new blocks for different purposes with Augelab Studio. These blocks can be easily accessible with popular software languages and libraries such as Python, Pyside, OpenCV, Open GL, Scikit-Learn, Keras, Tensorflow, and YOLO (Çetin et al., 2022).

Development of the Block Model

As mentioned above, ready-made function blocks provided by the software are visually modeled by connecting in the classification and area calculation process. In this context, in the determination of rice parcels and areas, blocks were created and connections were provided according to the flow chart below (Figure 2).

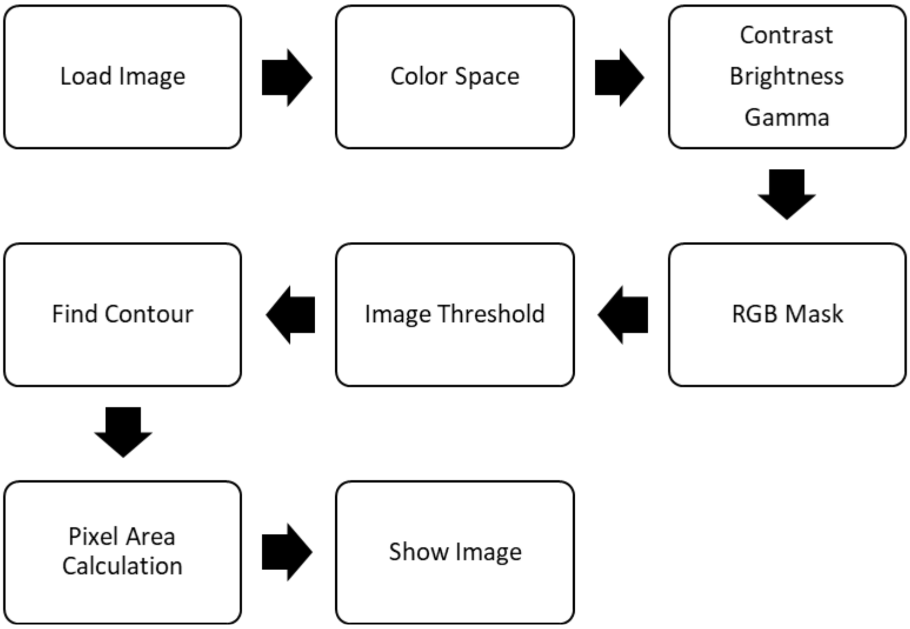

Figure 2. Application flowchart

Load image block provides loading of images to be processed. In Red Green Blue (RGB) mask, the most common color space, colors are represented by red, green, and blue components. RGB consists of a trio of colors. Each one can take a value between 0 and 255. This line is represented by black (0, 0, 0) and white (255, 255, 255) color range. RGB is used for masking using a "doped" color space (Stone, 2022).

The areas of the other rice parcels were determined by the coefficient created by taking the pixel values of some parcels whose total area is known as a reference. Three stage filtering blocks were used to separate the rice plots from other crop production plots. These are color space, contrast-brightness-gamma, and RGB masks, respectively (Figure 3).

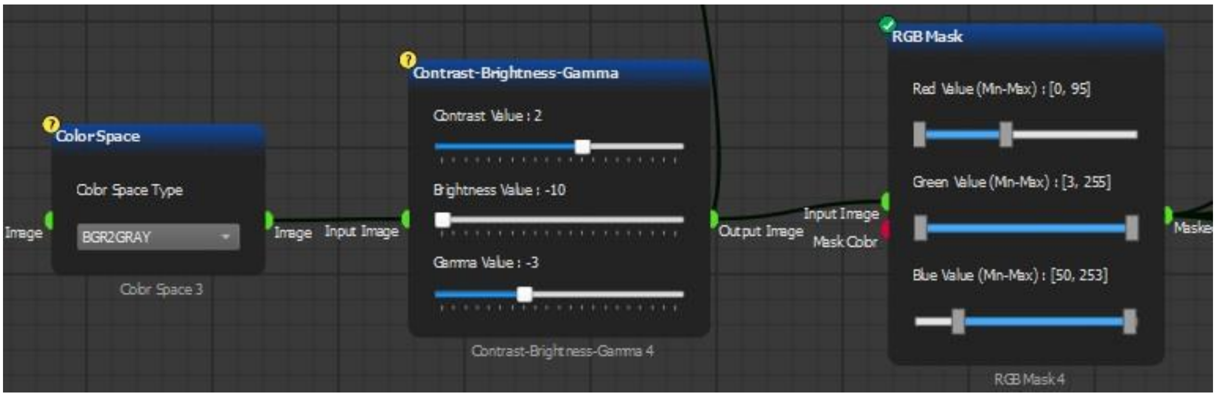

Figure 3. Color space, contrast-brightness-gamma, and RGB mask function blocks

Color space is the process of defining the desired color range in the spectrum of RGB values on a visual plane. Contrast-Brightness-Gamma block consists of 3 parts. The mid-tones disappear when the contrast setting is increased. The image has a higher proportion of dark or black and white or light tones with minimum mid-tones. When Brightness is adjusted, the entire tonal range in the image can be increased or decreased accordingly. Gamma is used to optimize the use of “bits” when processing an image, or the bandwidth used to carry an image, by taking advantage of the non-linear way humans perceive light and color (Grupta, 2021).

To ensure that the parcels in the image are paddy rice parcels, 2 agricultural enterprises producing paddy rice were contacted in that area, and the comparison was made and accuracy was determined. After these filters were applied, the rice parcels were visually separated from the other plant parcels as seen in (Figure 4).

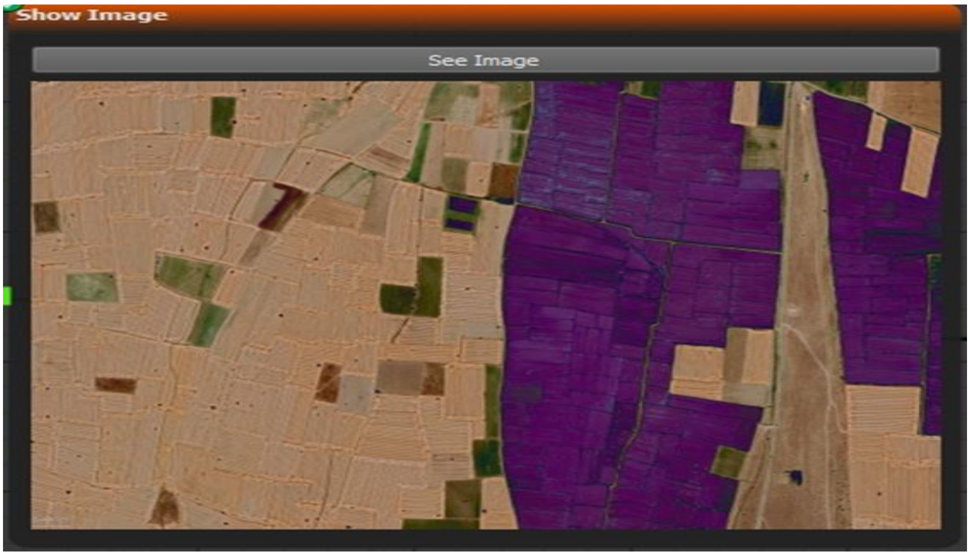

Figure 4. Separation of rice parcels after filtering

Image threshold and find contour blocks are used to find and calculate the areas of rice parcels that appear after the filtered image (Figure 5). The Image threshold function block is a type of image segmentation where users change the pixels of the image to make it easier to analyze the image. Image threshold was used to convert an image to a color or grayscale binary form, in other words, only black and white (Anonymous, 2022).

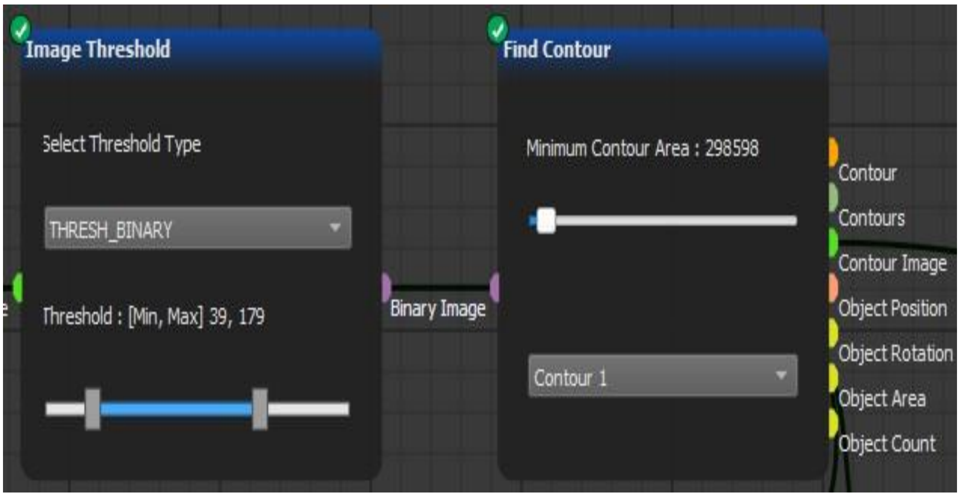

Figure 5. Image threshold and find contour

The find contour function block is used to find the size of the object of interest in shape analysis and object detection (Kumar, 2019). In Figure 6, the lines connecting all points along the border of an image with the same density (green line) are automatically divided into four areas.

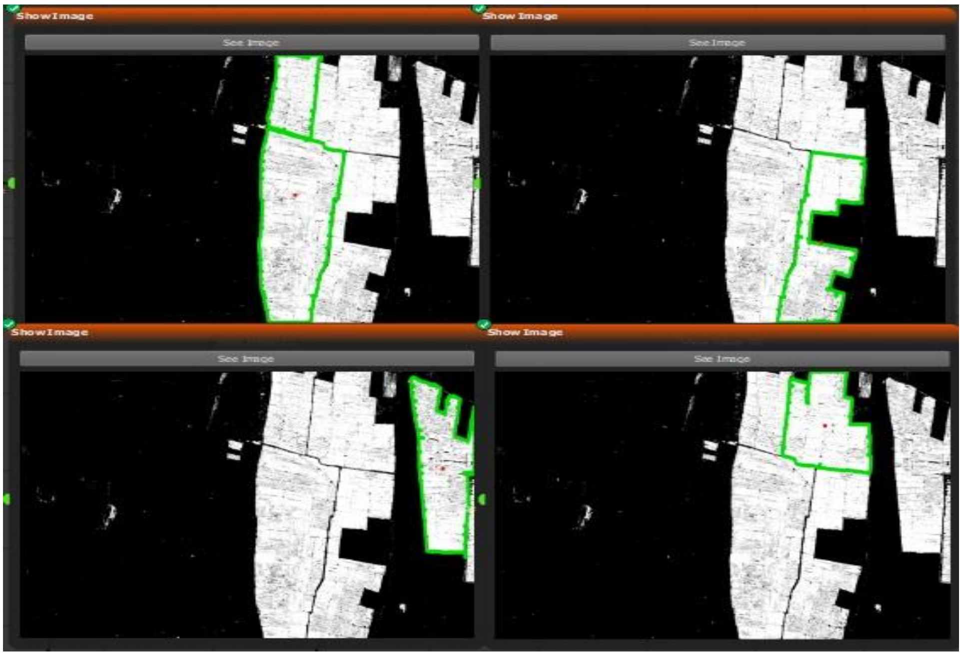

Figure 6. Paddy rice parcel fields in the image

The areas of the other rice parcels were determined with the object area value obtained from the Find contour function block, that is, the pixel area, and the coefficient created by taking the hectare values of some of the parcels whose total area is known as reference (Figure 7). As a result of this coefficient applied to other known parcels, the actual area values were determined.

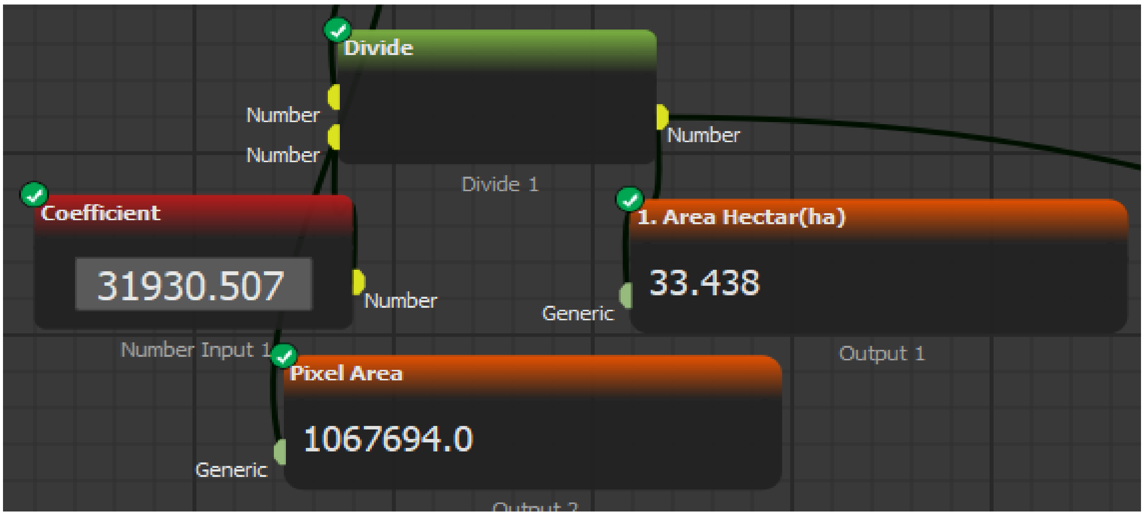

Figure 7. Calculation of areas of rice parcels

Results and Discussion

The raw view of the paddy rice parcels separated from other crop production areas is given in (Figure 8). From the image, it is seen that all the parcels in the rice planted area are separated from each other.

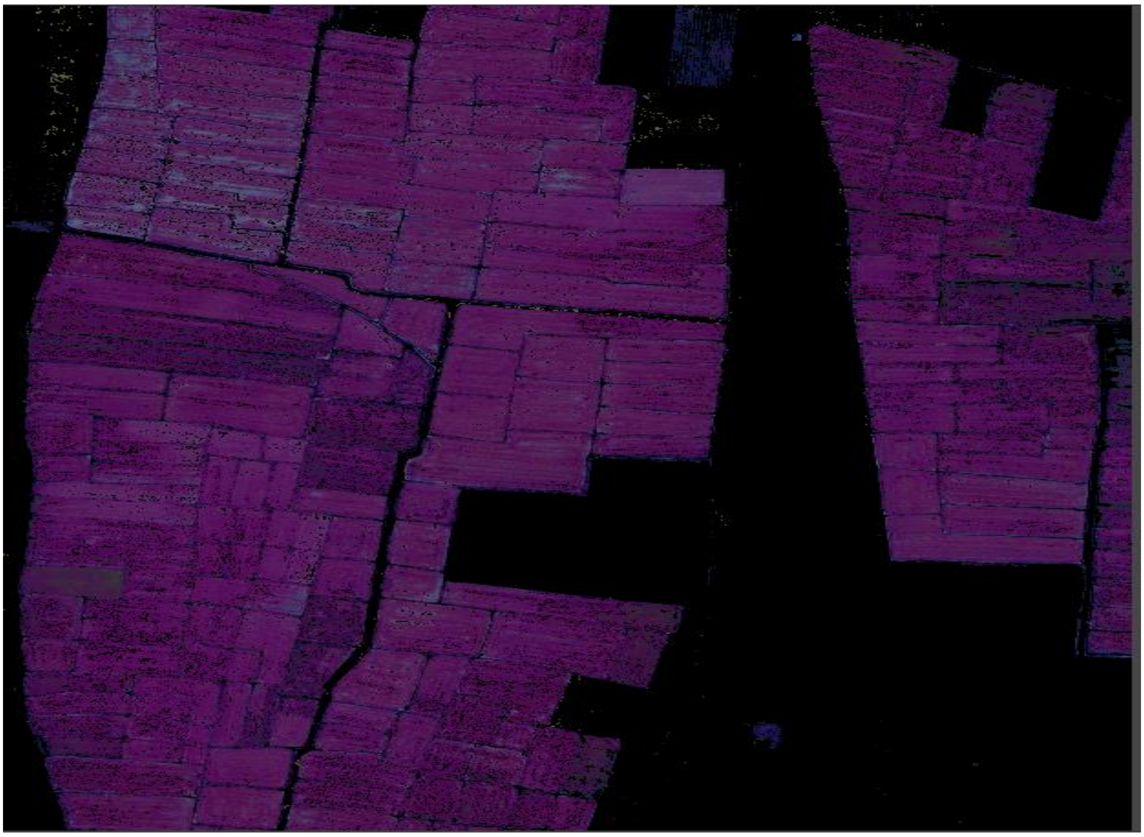

Figure 8. Image of rice parcels

The total area of 298 rice parcels in the study area was determined as 79.8 hectares in the Augelab Studio program. The total area in question was found to be 80.1 hectares in the measurements made on Google Earth Pro (Table 1).

Table 1. Augelab Studio and Google Earth Pro area calculations

Areas	Augelab Studio (ha)	Google Earth Pro (ha)
Contour 1	33.4	33.8
Contour 2	16.4	16.2
Contour 3	15.9	15.9
Contour 4	14.1	14.2
Total hectare (ha)	79.8	80.1

As can be seen, the software used can calculate parcel areas very precisely. It should be noted that the purpose here is not just to calculate plot areas. By determining the paddy rice planted areas with RGB images, the area measurements were also determined with the same algorithm. Avcı and Suna (2014) reported that they detected paddy rice parcels with high accuracy by using a pixel-based approach in their study on the detection of paddy rice parcels. Many different software were used in this study. However, it is seen that it is sufficient to determine the rice parcels using only AugeLab Studio without the need for different software.

Conclusions

This study was carried out to determine rice parcels and fields by using the Augelab Studio program, which includes new approaches in artificial intelligence supported image processing technique. By using the Augelab Studio function blocks and filters from the satellite images of the relevant area, only the rice parcels were mapped and the area calculated. As a result of these calculations, all of the rice-grown plots could be determined accurately on RGB images using only simple filtering functions. In addition, the total surface area of these parcels could be calculated with high accuracy.

It has been seen that the software used in the study will be very useful in production planning because it provides an user-friendly approach and can be accessed free of charge. In addition, since it allows real-time images to be processed instantly, it can also ensure that images obtained from unmanned aerial vehicles such as drones can be processed in a short time. In this context, it is planned to carry out studies in different areas such as disease detection and water stress determination by using instant drone images in the following stages.

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Authors' Contributions

All authors have participated sufficiently in the work take responsibility for the content.

Conflicts of Interest Statement

The authors declare no competing interests.

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