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PALM TREES COUNTING USING REMOTE SENSING AND GIS TECHNIQUES

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Abstract

Iraq is considered as one of the major suppliers of dates in the world. Dates are one of strategic products in Iraq. A production breakdown from 2004 until now, which called on the Ministries of Agriculture and The Ministries of planning to take care of palm statistics and studies to identify the imbalance and find solutions. We made a pilot project study using very high resolution satellite images with remote sensing and GIS techniques to calculate palms, to suggest a method which can reduce the time and save money comparing with field and manual calculation. We used two techniques and two types of satellite images to calculate palm trees then analyse the results finding that we can get good accuracy which can checked by field calculations to limit the real accuracy assessment.

1. INTRODUCTION

Many historians reported that the earliest known date for palms was in the Mesopotamia region, especially in the city of Babylon Which dates back more than 4,000 years BC, and the city of Aridu. It was a major area for date palms. The first documented appearance of date Palm tree was in the Old World in the sites of Tel Awaily and Tel Abu months in Arrido city (Ur), 4000 years BC. Where he found a lot of Sumerian inscriptions indicating the present of palms in that area. [1]

Iraq is considered one of the major suppliers of dates in the world. Dates are a strategic products in Iraq. It was considered with great interest. We note the increase in production from 488 thousand tons in 1988 until reaching the peak of 2000 with a production of 932 thousand tons. This value up to 2003 amounted to 790 thousand tons. A production

breakdown in 2004 reached only 402 thousand tons. Production continued with a simple gradual increase to reach 589 thousand tons in 2012. This production constitutes about 63% of the production in 2000, which called on the ministries of agriculture and planning to take care of palm statistics and studies to identify the imbalance and find solutions.[2]

The palm trees are limited to the area between Mandali and Tikrit at a latitude of 35 degrees north , Faw city at 30 degrees south latitude. The palm trees are distributed in 13 governorates: Basra, Maysan, Wasit, Dhi Qar, Muthanna, Qadisiyah, Najaf, Karbala, Babil, Anbar, Baghdad, Diyala and Salahaddin. The main governorates in the palm grove are: Basra, Babil, Baghdad, Diyala, Wasit and Dhi Qar. [1]

The palm growing and date production in Iraq face several obstacles and problems that have been going on for about 20 years. The number of palm trees has decreased and the palm production has decreased. [3], so Ministries of Agriculture and The Ministries of planning take care of palm trees statistics and studies to solve the problem.

New technologies may be able to satisfy the nation's forest information needs. An important development over the past quarter-century has been the deployment of Earthobserving satellites and rapid improvements in computing power and algorithms to interpret space-based imagery. Now that these technologies have been available for a significant period of time, how have they been integrated into forest monitoring practice and, importantly, exploited by decision makers. [4]

Satellite remote sensing provides fundamental data for the observation of spatial and temporal forest patterns and processes. While new remote-sensing technologies are able to detect forest data in high quality and large quantity, operational applications are still limited by deficits of in situ verification. [5]

2. MATERIALS AND METHODS

2.1 Study Area

The study area located in Mahmodai to the south east of Baghdad, the area of interest selected for this pilot project is 12 Km^2 as rectangular 3 x 4 km, located between UL(452000, 3672000) and LR(456000,3669000).

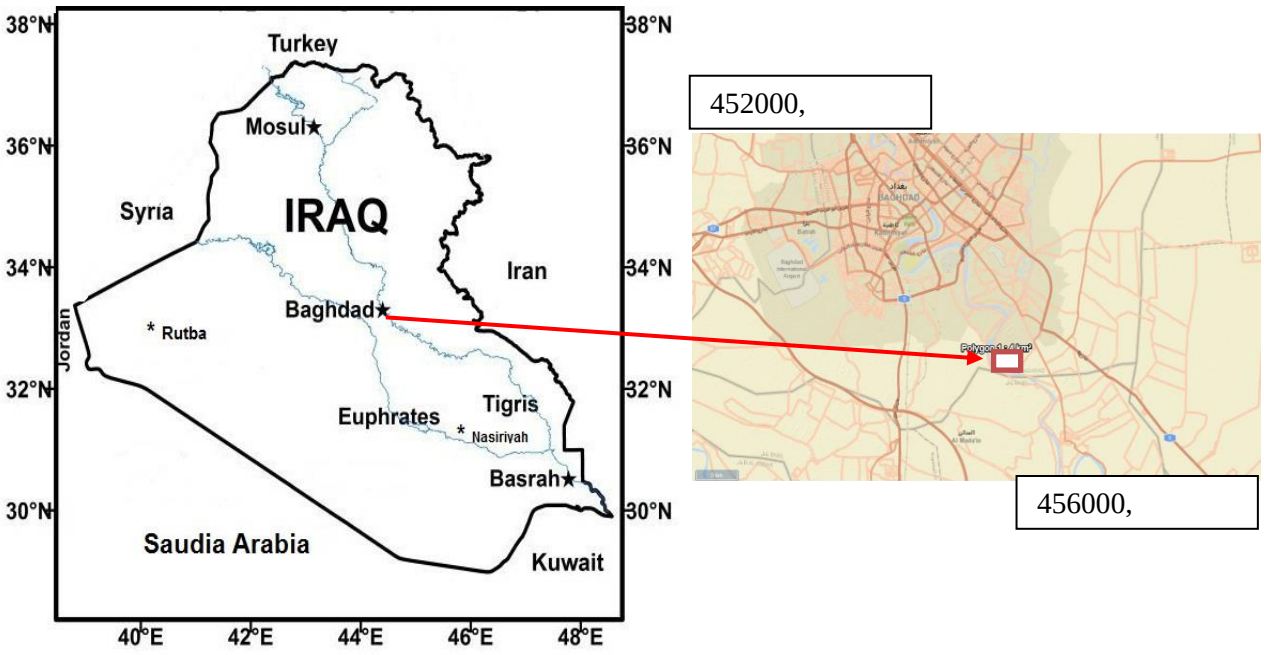

Figure 1. Study Area Location

2.2 Data and Tools

The following data and tools were used in this case study:

1- Pleiades image 50cm resolution, dated 20 March 2017.
2- Spot-6 image 1.5m resolution, dated 17 May 2017.
3- ERDAS Imagine V.16, software for image Processing.
4- Geomedia Professional V.16 software for GIS.

2.3 Scope of Work

This summary paper presents the results of a pilot study to assess the effectiveness of using satellite imagery to count palm trees for a test area in Iraq, with the following objectives:

1- Obtain and process archive Pleiades (0.5m resolution) and SPOT (1.5m resolution) satellite imagery.
2- Count palms manually and by applying machine-learning techniques based on both the Pleiades and the SPOT imagery.
3- Undertake a comparison between the palm counts based on the source data and counting approach.

4- For comparison purposes the palms manually counted from the Pleiades data are assumed to be the most accurate representation of the true palm count for the area. A true verification of the results would require palm count from a comprehensive field survey.

5- Further exploration of the results, can be undertaken, by reviewing the ArcMap project accompanying this study.

2.4 Methodology

Two approaches were used to count palm trees:-

1. Manual Counting:

- Manual counting was performed in the digital Geomedia Professional GIS Software environment, with each Palm tree captured as a single point within a geodatabase.
- Palm trees were found to have distinctive appearance on the imagery, although identification was more difficult where the trees were smaller in size as the characteristic appearance of the palms was not as clearly defined.
- Manual Palm counting using the SPOT imagery was found to be difficult, due to resolution limitations, and so manual counting was only completed for the Pleiades imagery. However, a machine learning approach was tested for the SPOT data, to see if this could give useful results.

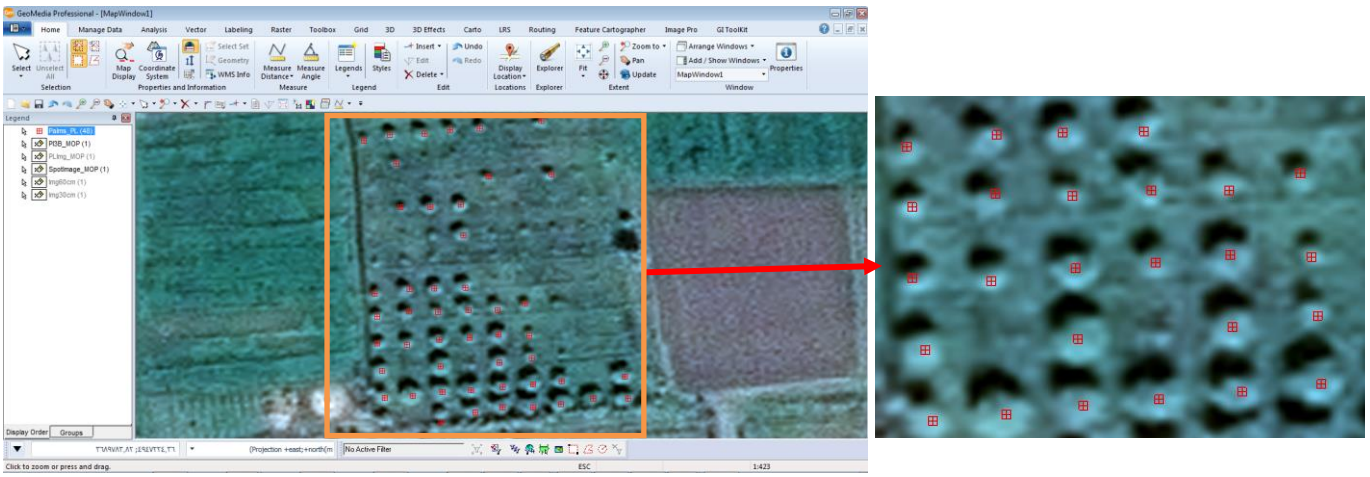

Figure 2. Manual Counting of Palm Trees

2. MACHINE LEARNING

Machine learning was undertaken using image objective ERDAS Imagine software, using the following general approach:

- Sample palm trees identified
- Templates generated & tested
- Thresholds adjusted
- No manual editing of the results was performed

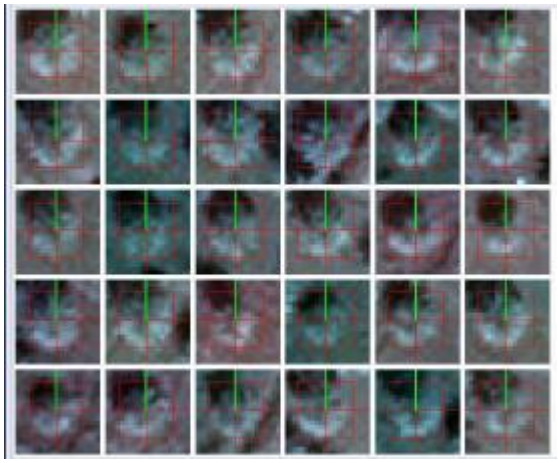

Figure 3. Template Matching Palm Trees - Pléiades

3. RESULTS AND DISCUSSION

For the complete study area using the manual counting from the Pleiades imagery a total of 8003 palms were identified, compared to 9741 from the automated Pleiades based approach. The Pleiades automated approach therefore identified around ~22% more palms than the manual Pleiades approach.

- For the SPOT automated approach for the complete study area a total of 8276 palms were identified, around ~3 % more than the manual Pleiades approach.
- Based on these results it could be concluded that the SPOT automated approach is more accurate than the Pleiades automated approach. However on visual inspection

of the distribution of the identified palms generated automatically from the SPOT imagery there are obvious misclassification errors, resulting in over counting is some areas and undercounting in others.

- Therefore, in order to undertake a more reliable exploration of the results, two smaller test areas were defined, with a contrasting density of palms:
    - Test area - dense
    - Test area - sparse

➢ Palm Count Test Areas - Dense

For the dense test area, in comparison to the manual Pleiades palm capture:

- Pleiades automated approach identified ~92% of the palms
- SPOT automated approach identified ~63% of the palms

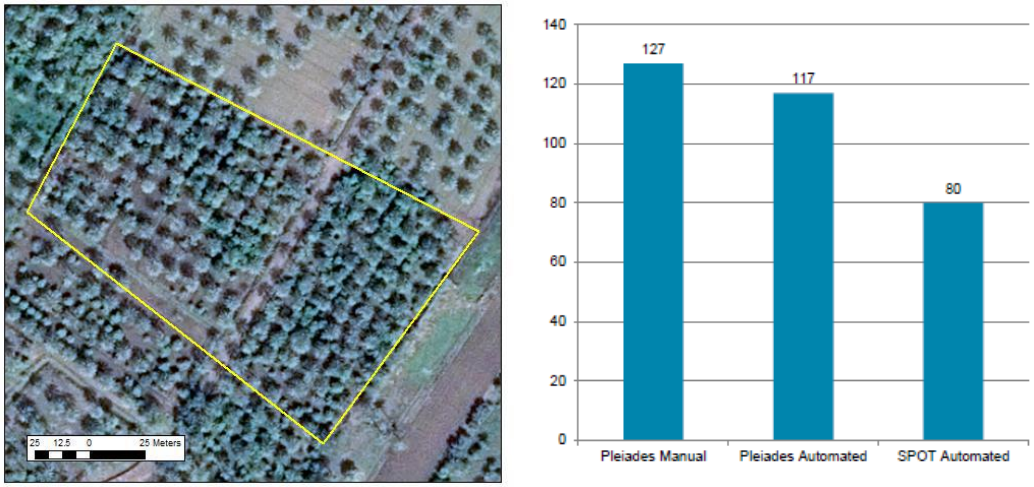

Figure 4. Palm Count Test Areas - Dense

➢ Palm Count Test Areas – Sparse

For the sparse test area, in comparison to the manual Pleaides palm capture:

- Pleiades automated approach identified ~95% of the palms
- SPOT automated approach identified ~88% of the palms

- For both image datasets, the automated approach appears more accurate for areas with sparse palm coverage. This would be expected as the individual trees are more clearly defined.

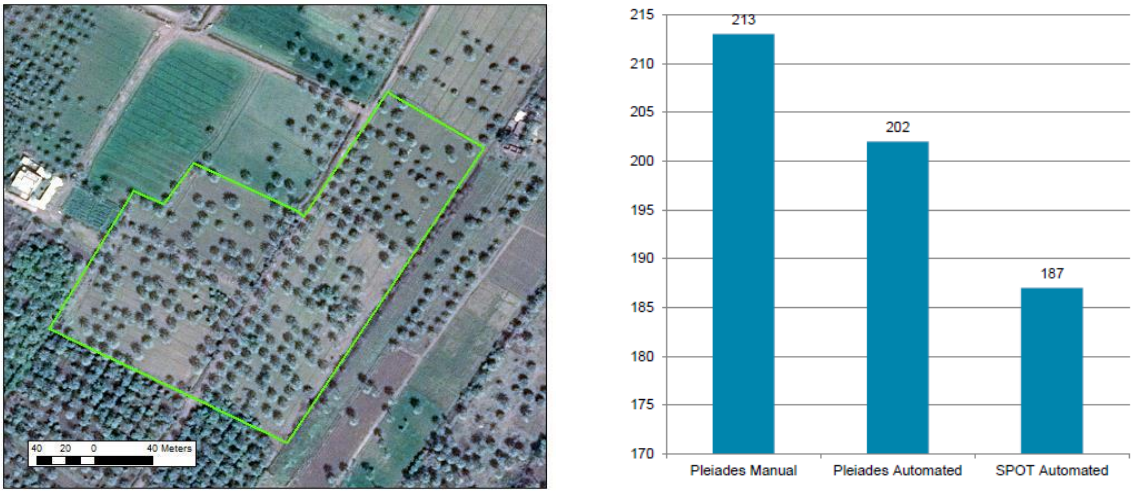

Figure 5. Palm Count Test Areas - Sparse

CONCLUSION AND RECOMMENDATIONS

Palm trees were successfully identified using a manual approach based on digital capture from 0.5 m resolution Pleiades satellite imagery. The resolution of the SPOT imagery was not deemed sufficient to reliably manually differentiate palms from other tree types, although an automated approach was still tested.

- A machine learning method based on the Pleiades imagery identified ~92% of the palms for the dense test area and ~95% of the palms for the sparse test area, compared to those palms identified using a manual approach. The machine learning method using the SPOT data is thought to be less reliable with a greater discrepancy to the total number palms counted using the manual approach for the test areas. A visual inspection confirms the limitation in using SPOT data, with the relatively lower resolution causing classification errors.

- There is potential to improve the machine learning approach used in this pilot study, by a larger training datasets and automatically masking out water bodies and other features which may cause miss-identification.
- Access to ground survey information on 'true' palm counts would allow a more accurate evaluation of the results.
- A feasibility study is recommended to assess the potential for a national service based on tasked imagery as this pilot study has shown promising results. A machine learning approach combined with manual checking/editing is thought to be the most efficient approach, with significant time savings over manual capture only methods.

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