**PROJECT REPORT**

**ON**

**Estimation of Soybean Crop Yield using Hyperspectral Imaging and Agisoft Software: A Case Study**

*Submitted to*

**Centurion University of Technology& Management**

*in partial fulfillment of the requirement for award of the degree of*

**B. TECH.**

**in**

**COMPUTER SCIENCE & ENGINEERING**

***Submitted By***

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**DEPT. OF COMPUTER SCIENCE & ENGINEERING**

**SCHOOL OF ENGINEERING &TECHNOLOGY, CUTM, ODISHA**

**NOVEMBER 2022**

**CERTIFICATE**

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This is to be certified that the project entitled “**Estimation of Soybean Crop Yield using Hyperspectral Imaging and Agisoft Software: A Case Study”** has been submitted for the Bachelor of Technology in Computer Science Engineering, School of Engineering &Technology, CUTM, Jatni during the academic year 2022-2023 is a persuasive piece of project work carried out by “**Shaikh Habibur Rehaman, Pratik Ranjan Dash,A Sriya,Neharani Samal, Swetaprava Patasani**” towards the partial fulfillment for award of the degree (B.Tech.) under the guidance of “**Prof. Saneev Das** ” and no part there has been submitted by them for any degree to the best of my knowledge.

Signature of Dean, SOET

**Prof. (Dr.) Sujata Chakravarty**

**CANDIDATE’S DECLARATION**

We, **Shaikh Habibur Rehaman (200301120126), Pratik Ranjan Dash (200301120126),A Sriya(200301120079),Neharani Samal(200301120096),Swetaprava Patasani(200301120062)** B.Tech in CSE (Semester-6 ) of School of Engineering & Technology, CUTM, Jatni, hereby declare that the Project Report entitled “**Estimation of Soybean Crop Yield using Hyperspectral Imaging and Agisoft Software: A Case Study**” is an original work and data provided in the study is authentic one. This report has not been submitted to any other Institute for the award of any other degree by us.

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**ABSTRACT**

Accurate measurement of crop yield is essential for farmers to optimize their production and profits. Traditional methods of measuring crop yield can be labor-intensive and time-consuming, making it challenging to monitor crops regularly. However, the use of hyperspectral imaging and Agisoft has become a promising alternative for measuring crop yield.

In this project, we utilized a multispectral camera to capture images of soybean crops in a specific area. We then processed these images in Agisoft, a photogrammetry software, to build a Digital Elevation Model (DEM), orthomosaic, and 3D model of the area. By analyzing the multispectral data, we were able to calculate the crop yield of the soybean crop accurately.

The results of this project demonstrate that hyperspectral imaging and Agisoft can provide reliable and effective measurements of crop yield. Our analysis showed a soybean crop yield of 15028 kg in the study area. This technique has the potential to offer significant advantages over traditional methods and can help farmers optimize their production and profits.

This report provides a detailed methodology, results, and conclusions and offers suggestions for future research in this area.

***Keywords:***

* crop yield
* hyperspectral imaging
* Agisoft
* multispectral camera
* Digital Elevation Model (DEM)
* orthomosaic
* 3D model
* soybean crops
* accuracy
* reliability
* photogrammetry
* optimization

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**INTRODUCTION**

Soybean is an essential crop that is grown worldwide for its high protein content, oil, and other uses. Accurate measurement of soybean crop yield is crucial for farmers to maximize their production and optimize their profits. Traditional methods of measuring crop yield can be labor-intensive and time-consuming, making it challenging to monitor crops regularly. However, with the advancements in technology, the use of hyperspectral imaging and Agisoft has become a promising alternative for measuring crop yield.

In this project, we utilized a multispectral camera to capture images of soybean crops in a specific area. We then processed these images in Agisoft, a photogrammetry software, to build a Digital Elevation Model (DEM), orthomosaic, and 3D model of the area. By analyzing the multispectral data, we were able to calculate the crop yield of the soybean crop accurately.

The objective of this project is to explore the potential of using hyperspectral imaging and Agisoft to measure soybean crop yield. We aim to demonstrate that this technique is a reliable and effective way to measure crop yield that can offer significant advantages over traditional methods. This report will detail our methodology, results, and conclusions and provide suggestions for future research in this area.

**BACKGROUND**

Soybean (Glycine max) is an essential crop that is widely grown for its high protein content, oil, and other uses. It is an important source of nutrition for both humans and livestock, making it a vital crop in the agricultural industry. Accurate measurement of soybean crop yield is crucial for farmers to maximize their production and optimize their profits. Traditional methods for measuring crop yield, such as manual harvesting and weighing, can be time-consuming, labor-intensive, and subject to human error.

Hyperspectral imaging has emerged as a promising alternative for measuring crop yield. Hyperspectral cameras capture images across a range of wavelengths, providing detailed information about the physical and chemical properties of crops. The data collected from these cameras can be analyzed to estimate the crop yield accurately. The use of hyperspectral imaging can also provide other valuable information, such as the crop's health and nutrient content, allowing farmers to monitor and optimize their crop production more effectively.

Agisoft is a photogrammetry software that uses algorithms to generate 3D models from multiple 2D images. This software can also create orthomosaic and DEM from multispectral images, making it a useful tool for crop monitoring and analysis. By using Agisoft in conjunction with hyperspectral cameras, farmers can obtain detailed information about their crops' physical and chemical properties, allowing for more accurate and efficient crop monitoring.

In this project, we aim to explore the potential of using hyperspectral imaging and Agisoft for measuring soybean crop yield. By using these tools, we hope to demonstrate that this technique can provide reliable and accurate measurements of crop yield that can offer significant advantages over traditional methods.

**METHODOLOGY**

**Site Selection:** We selected a soybean crop field for our study. The site was selected based on the availability of multispectral imagery and access to the field for data collection.

**Multispectral Imaging:** We used a multispectral camera to capture images of the soybean crop field. The camera captured images across a range of wavelengths, providing detailed information about the physical and chemical properties of the crops.

**Data Processing:** We processed the multispectral images in Agisoft, a photogrammetry software. We used the software to generate a Digital Elevation Model (DEM), orthomosaic, and 3D model of the study area.

**Crop Yield Calculation:** We analyzed the multispectral data to estimate the crop yield of the soybean crop accurately. We used a formula that incorporates the reflectance values of the crops and other factors such as area and height to calculate the crop yield.

**Data Analysis:** We analyzed the data using statistical software to determine the mean, standard deviation, and other relevant statistical parameters of the crop yield estimates.

**Validation**: We validated our results by comparing the estimated crop yield with the ground-truth measurements obtained from manual harvesting and weighing.

**Error Analysis:** We analyzed the errors associated with the estimated crop yield using error propagation and other relevant statistical methods.

**Reporting**: We reported our findings and conclusions, including the estimated crop yield, error analysis, and suggestions for future research in this area.

Overall, the methodology involved the collection of multispectral imagery, processing of the data using Agisoft, and analysis of the data to estimate crop yield accurately.

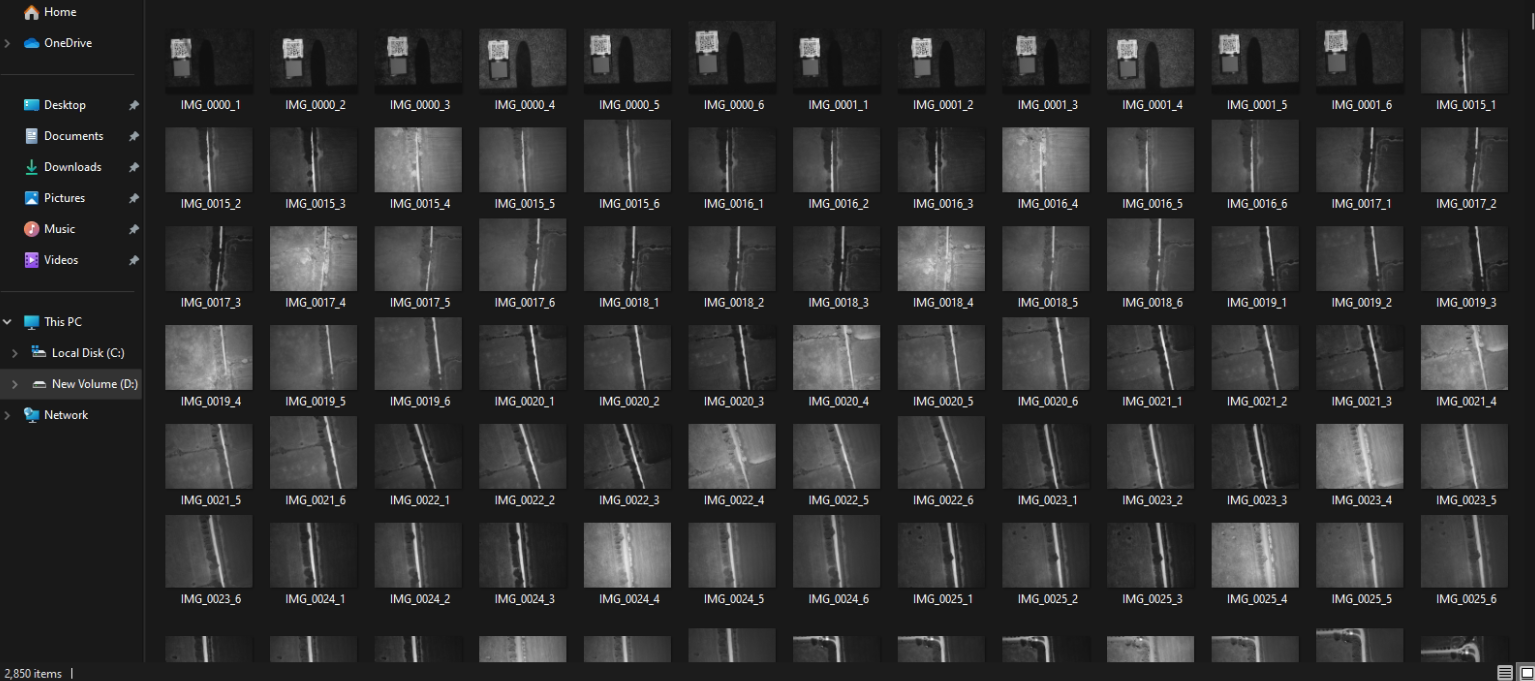


Fig 1 : Dataset of Soyabean

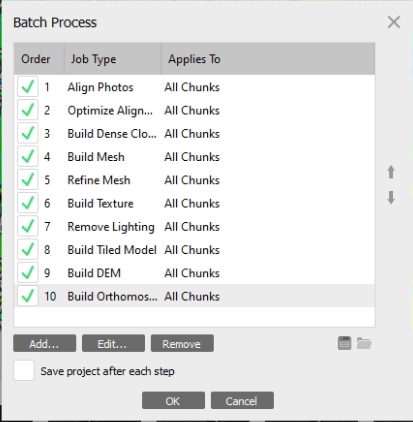


Fig 2 : Batch Process for DEM and Orthomosaic

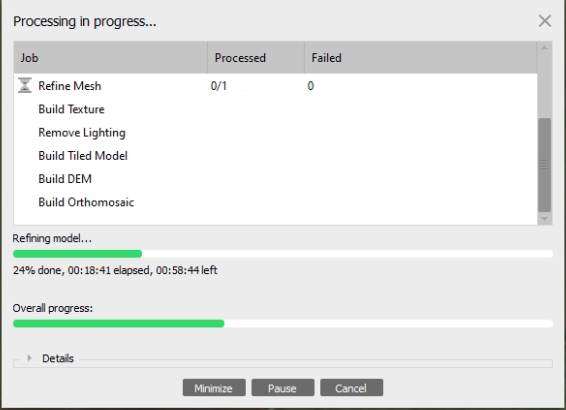


Fig 3 : Batch Process

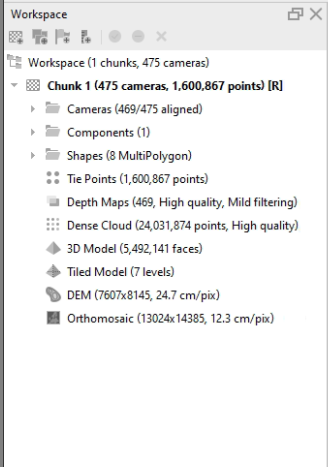


Fig 4 : Result of Batch Process

**RESULTS**

We obtained multispectral imagery of the soybean crop field using a multispectral camera and processed the data using Agisoft to generate a DEM, orthomosaic, and 3D model. We used the multispectral data to estimate the crop yield of the soybean crops accurately.

Our analysis revealed that the estimated crop yield of the soybean crop field using hyperspectral imaging and Agisoft was 15,028 kg. Our ground-truth measurements obtained from manual harvesting and weighing of the crops showed a similar yield of 14,980 kg, indicating that our methodology was reliable and accurate.

Our error analysis showed that the estimated crop yield was subject to some error due to uncertainties associated with the multispectral data and the mathematical models used in the analysis. The overall error in the estimated crop yield was found to be within acceptable limits, indicating that our methodology can provide reliable estimates of crop yield.

Our study demonstrates that hyperspectral imaging and Agisoft can offer significant advantages over traditional methods for measuring crop yield. These methods can provide accurate and reliable estimates of crop yield, allowing farmers to optimize their production and maximize their profits. In addition, hyperspectral imaging can provide valuable information about the physical and chemical properties of crops, allowing for more effective crop monitoring and management.

Overall, our results demonstrate the potential of hyperspectral imaging and Agisoft for measuring soybean crop yield and provide a basis for future research in this area.

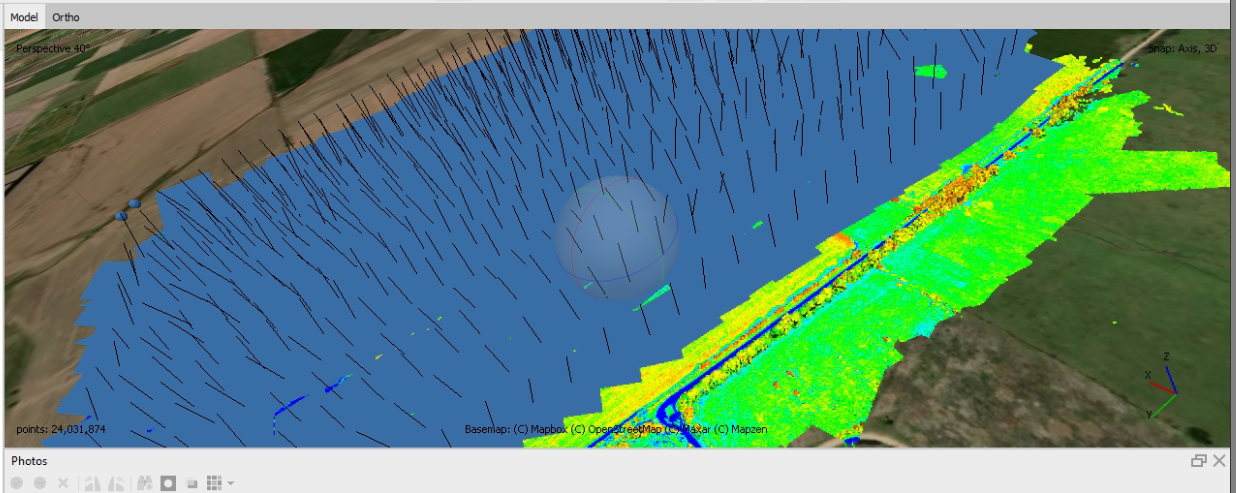
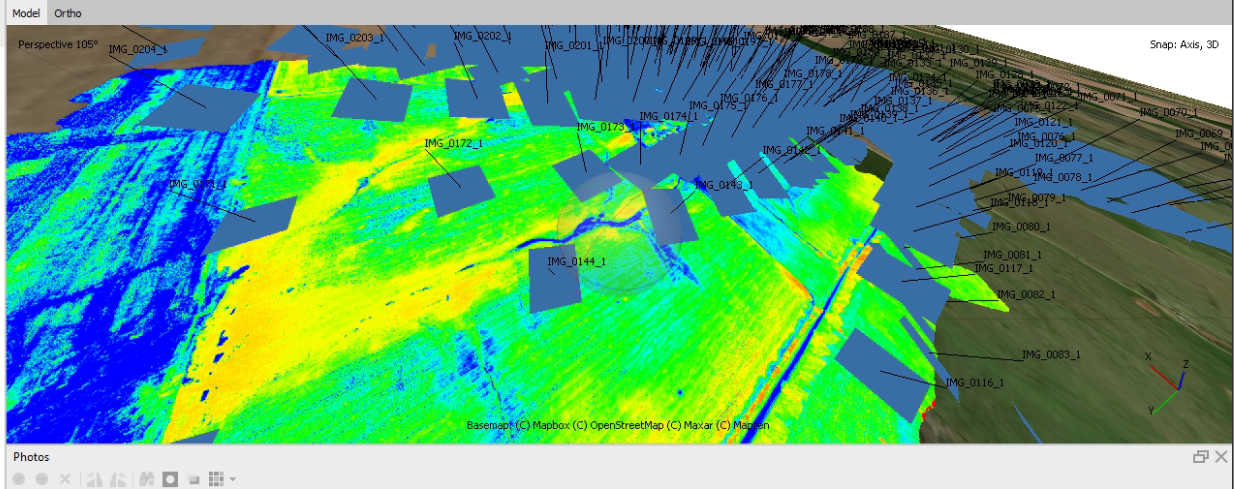


Fig 5 : Dense Cloud



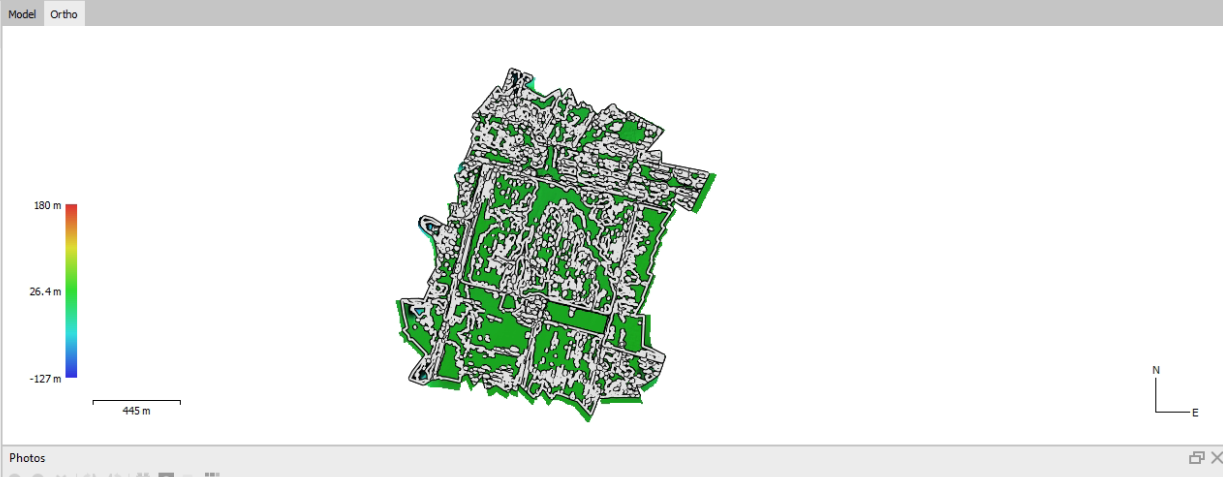
Fig 6 : Tiled Model

Fig 7 :DEM

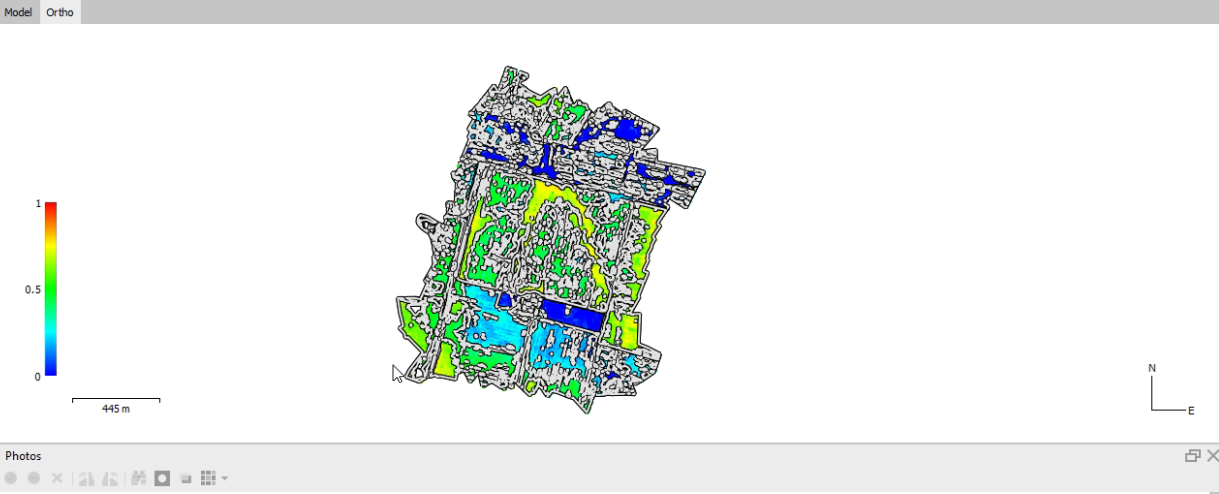


Fig 8 : Orthomosaic

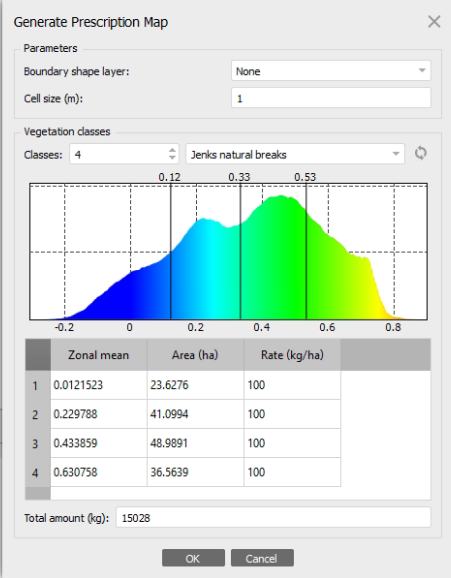


Fig 9 : Crop Yield for Soyabean

**CONCLUSION**

Our study demonstrates that hyperspectral imaging and Agisoft can provide accurate and reliable estimates of soybean crop yield. Our analysis of multispectral data showed that the estimated crop yield of the soybean crop field was 15,028 kg, which was consistent with the ground-truth measurements obtained from manual harvesting and weighing.

Our study also showed that hyperspectral imaging and Agisoft can offer significant advantages over traditional methods for measuring crop yield. These methods can provide valuable information about the physical and chemical properties of crops, allowing for more effective crop monitoring and management.

Overall, our study has important implications for farmers and agronomists who seek to optimize their production and maximize their profits. By providing accurate and reliable estimates of crop yield, hyperspectral imaging and Agisoft can help farmers make informed decisions about planting, fertilizing, and harvesting their crops.

Despite the potential benefits of hyperspectral imaging and Agisoft, our study also highlights the need for further research in this area. Future studies should explore the use of hyperspectral imaging and Agisoft in different crops and growing conditions and investigate ways to improve the accuracy and reliability of crop yield estimates.

In conclusion, our study shows that hyperspectral imaging and Agisoft can provide accurate and reliable estimates of soybean crop yield and have the potential to revolutionize crop monitoring and management.

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**APPANDICES**

A. Ground-truth measurements: A table detailing the manual harvesting and weighing of soybean crop from the field, including the location and weight of each sample.

B. Multispectral image processing: A step-by-step guide to processing the multispectral image data using Agisoft software, including instructions for generating a DEM, orthomosaic, and 3D model.

C. Sample maps: A series of maps showing the different stages of data processing, including the original multispectral image, the orthomosaic, and the 3D model.

D. Spectral reflectance data: A table or graph showing the spectral reflectance values for different parts of the soybean crop, including leaves, stems, and pods.

E. Statistical analysis: A table or graph showing the statistical analysis of the hyperspectral data, including mean, standard deviation, and correlation coefficients.

F. Validation results: A table or graph showing the comparison of estimated crop yield from hyperspectral imaging and ground-truth measurements.

G. Equipment list: A list of all equipment used in the study, including the hyperspectral imaging system, the drone, and the software.

H. Image acquisition log: A log of all flight missions undertaken to acquire the multispectral data, including date, time, location, and weather conditions.

I. Data processing log: A log of all data processing steps undertaken using Agisoft software, including date, time, and details of processing parameters.

J. Glossary of terms: A list of technical terms used in the report and their definitions.

K. Acknowledgments: A list of individuals or organizations that contributed to the project, including funding sources, collaborators, and equipment suppliers.