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Generated Topographic Data from UAV, For Simple Irrigation Planning (Case Study, Sugar Cane in Jember)

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***Abstract*— *Simple irrigation is a type of irrigation with a coverage of less than 500 ha. This research is in the sugar cane area in Jember, East Java. The research location covers area about 10.25 ha, dominated by sugarcane, with a small amount of corn and soybean fields. This study uses a UAV with an 8.8 mm focal length camera, 1-inch sensor, and 20 mp. Aerial photo recording results will be processed into orthophoto and Digital Surface Model (DSM). Orthophoto is used to calculate the accuracy of X and Y maps based on RMSE, while DSM is used to calculate RMSEz, both using 90 % of confidence. Digital Terrain Model (DTM) as topographic data is made from DSM using the Vosselman algorithm namely Slobe Based Filter (SBF). The filter process uses two parameters: first a slope value of 50 with a radius of 1 m and second a slope value of 0.50 with a radius of 10 m. Calculation results show RMSE value of 0.05m at 90% confidence level, which is accepted on a scale of 1: 1000. In addition, the elevation data value of RMSEz is 0.06 with a confidence level of 90%, which is accepted on a scale of 1: 2000. The filter parameter results show that the second parameter (a slope value of 0,50 with a radius of 10 m) is better than the first parameter in separating ground and non-ground.*

***Keywords*— *Unmanned Aerial Vehicle (UAV), Digital Surface Model, Orthophoto, Irrigation*.

I. Introduction

Nowadays, the development of technology and innovation is very rapid, such as the development of UAV for mapping. Aerial photographs taken using UAVs have high potential in getting Digital Surface Models (DSM) for the fulfillment of topographic data which can be very useful for obtaining information about simple irrigation.

DSM data cannot be directly used as topographic information. A process must be done to extract Digital Terrain Model (DTM). In order to make the DTM data, a filtering process is carried out.

Point cloud data in the form of Digital Surface Model (DSM) is processed into DTM by utilizing the vosselman algorithm method. The vosselman algorithm is an algorithm used to scan the high differences between points. The parameter values used in scanning are the slope values between points. The basic idea of this method is to separate the point cloud by paying attention to the slope of the data (Vosselman, G. 2000).

Digital Elevation Model (DEM) is a group of discrete measurements in a three-dimensional coordinate system of a Cartesian coordinate system or X, Y and Z. Several methods can be made to obtain point cloud data such as laser scanners, Photogammetry, Laser Altimetry and Lidar. Each data source produces a different quality point cloud. DSM are data which describe elevation data models covering all of the earth's surface, such as trees, buildings, car plants, and others. Whereas DTM is describing one type of information which is terrain data or ground data without regard to information on the surface. (Zhou, 2017)

There are several steps in irrigation network planning process, namely Survey, Investigation, Design, Land Acquisition, Construction, Operation, and Maintance. In the first point of planning stage, Survey, some approaches can be us, such as aerial photography (if any), topographic measurements, and land suitability research (KP-01, 2013).

This study uses aerial photographs from the Unamned Aerial Vehicle (UAV). Aerial photography is processed into two products: orthophoto product is used as land condition information and Digital Terrain Model (DTM). The results of data processing are used as survey material and land investment before designing the irrigation network. The use of aerial photographs as references in the survey and investment process aims to facilitate the process of collecting orthophoto data and topographic results from the processing of point cloud.

II. Page Layout

The study area in sugar land, Jember east java, Indonesia, it was 24,8 ha with coveage area of aerial photo 109,25 ha.

Fig. 1. Study Location

Tools

This research using tools:

a. GPS Geodetik Geofennel f1
b. UAV DJI Phantom 4 Pro

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c. Premark
d. camera
e. Smartphone
f. Pix4d Capture
g. Saga GIS
h. Agisoft

III. METHOD

Making data mission flights using the pix4d mapper application. Flying height is 200 meters, 70% of sidelap and overlap and camera angle about 0^0. GCP point planning is done by calculating the area and boundaries to be mapped. The estimated amount of GCP used follows the pattern of landforms. GCP placement positions are created in accordance with GCP requirements (BPN-Juknis UAV, 2017)An easy way to comply with the conference paper formatting requirements is to use this document as a template and simply type your text into it.

IV. PROCESSING DATA

All aerial photographs are collected and corrected (no oblique photos), then processed in order to create point clouds and orthophoto. Stages in general are

a. align photo
b. camera calibration
c. orthorectification
d. export
e. Filtering Method

The accuracy analysis calculations are carried out between the model and measurements in the field. It performed in order to determine the quality of the map. For this step, rule from Geospatial Information Agency 2015 is used. It state about map accuracy values in X, Y and Z.

V. RESULT ANF DISCUSSION

Data recording uses UAV, with flight missions using the Pix4d mapper application. Data recording time starting at 09:00 WIB until the maximum at 15:00 WIB. Flight missions are based on work area boundaries and made into three lines. The following figure is an example of aerial photographs taken in the study area.

Fig. 2. Exif sample data aerial photography

TABLE I. Information metadata.

No	Name	Description
1	Title	DJI 0005
2	Date Taken	25/10/2018
3	Dimension	5472 x 3648
4	Resolution	72 dpi
5	F-Stop	f/6,3
6	EXP Time	1/5000

After processing, the all aerial photograph will be mozaiking, the result orthphoto for showing condition in field. orthophoto be showing at figure 3.

From aerial photo, the orthorectification process of X, Y and Z values is performed, which including the distribution of GCP points. According to Ebert, 2015, the Orthorectification Process is repositioning the image according to its actual location, because when recording data it experiences a shift (displacement). After the orthorectification process the digital image is called otrhophoto, in the application the orthphoto process is selected. From the measurement results of X and Y coordinates, the values of x and y are used as an orthorectification process.

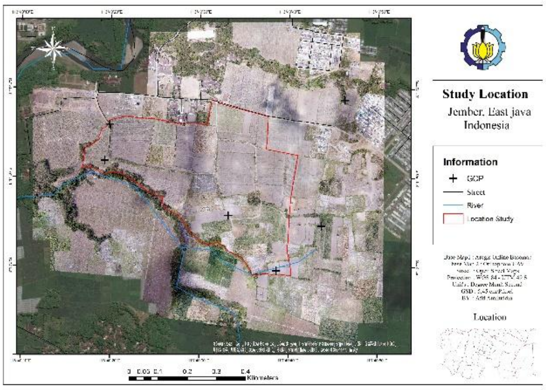

Fig. 3. Exif sample data aerial photography

TABLE II. Position GCP

No	X (m)	Y (m)
1	795234.1960520	9093180.8554046
2	794408.1502198	9092976.8527618
3	794425.0708986	9093100.3627225
4	794996.7423648	9092594.8694372
5	795152.5798222	9092748.3311365
6	794832.2844916	9092785.6614052

The coordinate value of the measurement will be calculated with the coordinate value on the image of the aerial photograph calibration. The calculation used refers to BIG number 15, 2014.

The orthophoto calculation results obtained a confidence value of 0.08 m, for Horizontal with a RMSE value of 0.061. The result map can be used for map of 1: 1.000 scale. Class 1.

Digital Surface Model

DSM (Digital Surface Model) from UAV will be procced in order to create

DTM using Slobe Based Filtering (SBF) method.

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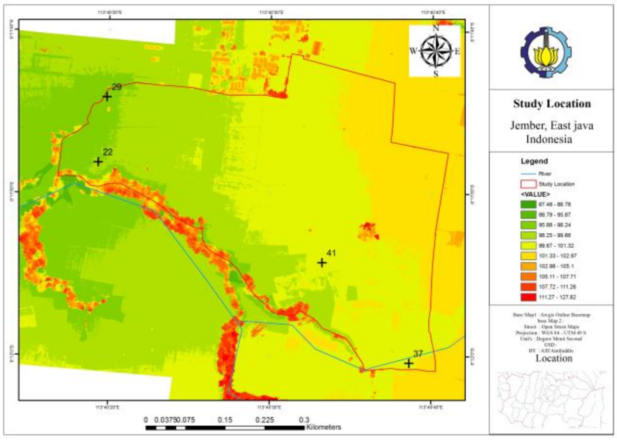

Fig. 4. Digital Surface Model

The values of Z calibration is 0.1 with an RMSE value of 0.061. The following is a table calculating the accuracy of the Z value. With the LE90 value of the map produced from Perka Big no 15 of 2014, this map can be used for a scale of 1: 1000 with a GSD value of 10cm / pixel.

TABLE III. Calculation of Z (m) value based on measurement calibration

No	Z (GCP)	Z (DSM)	(D Z)	(D Z)^2
1	102.688	102.7008723	-0.01287	0.00016570
2	101.848	101.9233486	-0.07535	0.00567741
3	101.295	101.1990067	0.095993	0.00921471
4	100.013	100.0218102	-0.00881	0.00007762
5	97.868	97.79434697	0.073653	0.00542477
6	98.162	98.20427241	-0.04227	0.00178696
			£	0.02234716
			Avarage	0.00372453
			RMSE	0.06102890
			LE90	0.10069158

The results of DSM calibration can be used for processing and reference in the initial study of simple irrigation design.

In order to obtain a better z value, waterpass or Total Station must be used for calibration and correction. Z value must be collecting from terrestrial method survey.

The next process is making DTM using 2 parameters methods. The first parameter is a slope of 5 degrees and for a radius of 1 m. The second parameter is a slope of 0,5 degrees and for a 10 m radius.

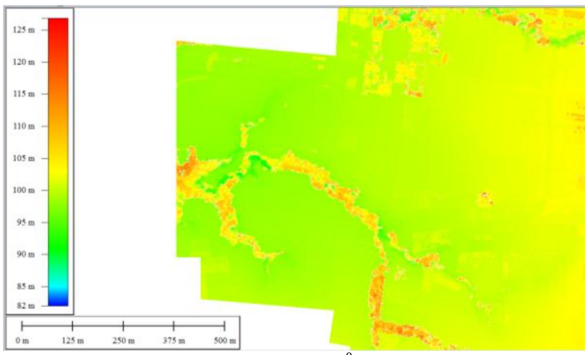

Fig. 5. The Bare Earth by Slope 5^0, Radius 1m Method.

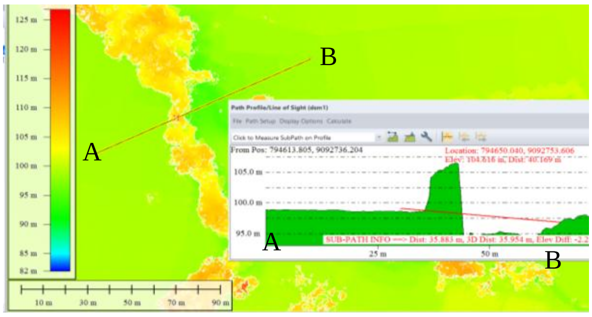

Fig. 6. Profile elevation a Segment A to B

Fig. 7. The Bare Earth by Slope 0.50 radius 10m method

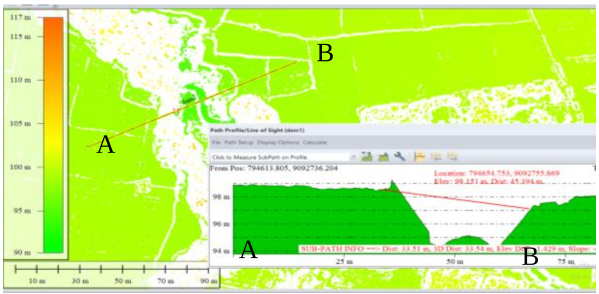

Fig. 8. Profile bare earth by slope 0,50 and radius 10m A to B

The filter process results using the first parameter produces data which still identifies elevation in not-terrain area. Figure 6 shows the profile form of the data generated where there are still elevations identified as trees. Therefore, the first parameter is not appropriate for the data used in this research. The results from the second parameters produce more effective separation. Figure 8 shows the elevation profile which excluded elevation in not-terrain area.

VI. Conclusion

The orthophoto map is used as a terrain identification product with an RMSE value of 0.005 and a confidence of 90% 0.08m. The maps accuracy scale included in class 1 (map scale 1: 1000). DSM map obtained RMSE value of 0.06 with LE90 value of 0.1m. Therefore, DSM map can be used for maps with a scale of 1: 2000. The parameter value used is the second parameter that is, the value of the slope parameter is 0.50 with a radius of 10

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