Unmanned aerial vehicle (uav) application for supporting climate change readiness program in depok municipality, indonesia

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Abstract. In 2019, Depok Municipality in Indonesia has participated for the second times in PROKLIM (Program Kampung Iklim-bahasa) which is focussed in RW 10 Baktijaya Village. In previous year, community activities in biopori holes, family herbal planting (TOGA) and rainwater infiltration well (RIW) was difficult to be updated. Therefore, in this study unmanned aerial vehicle (UAV) is applied to acquire location of PROKLIM in Baktijaya village with very high resolution image. Herein, DJI Phantom 4 Pro was flown at 100 m height to capture images of participated houses. The image from UAV then processed with Agisoft Photoscan to generate orthophoto image. With the guidance from local community leader, biopori hole, TOGA and RIW locations were tagged using Avenza Maps and input into ArcGIS. Layers from UAV images and field survey then integrated to produce maps of biopori hole, TOGA and RIW activities. The map of PROKLIM activities was successfuly generated from UAV image and Avenza Maps application. Resulted maps are very useful for updating submission to PROKLIM registration website in Indonesia’s Ministry of Environment and Forestry.

1. Introduction
Since 2012, the Indonesia’s Ministry of Environment and Forestry (MoEF) has launched PROKLIM (program kampung iklim-bahasa) regulation. The main purpose of climate change readiness program (PROKLIM) is to increase climate change awareness to enhance communities’ participation for understanding the climate change and its effects, so that all parties are encouraged to do real action and community empowerment in facing climate change and reducing greenhouse effect [1].

In 2019, the Government of Depok Municipality in Indonesia has participated for the second times. In this event, the Government of Depok Municipality has set RW (rukun warga-bahasa) 10 in Baktijaya Village as the location of PROKLIM. In previous year, participated communities have problems concerning data updating of 3 main activities in PROKLIM assessment namely biopori holes, TOGA (tanaman obat keluarga-bahasa), and rainwater infiltration well (RIW). In the next sentences, these 3 activities will be abbreviated as BIOPORI, TOGA and RIW.

Since climate change can increase the disaster risk of water scarcity and drought, harvest failure, sea level increase and dengue/malaria [1], therefore these 3 activities of PROKLIM have vital role in determining the success of climate change readiness program. BIOPORI holes are effective to prevent puddle and to decompose organic garbage [2]. Meanwhile, family herbal medicine or known as TOGA improves family nutrition and potentially increases family revenue [3]. Last but not least, RIW is water conservation engineering effort with water well-shaped concrete functioned to store rainwater underground [4]. All of these activities are subject to PROKLIM assessment by the team from MoEF.
When these indicators are implemented by the communities and successfully acknowledged by the ministerial observer, then the PROKLIM location will have positive values. Therefore, these 3 activities are needed to be recorded spatially to give information for stakeholders which location is enough and which is to be added more.

Ordinary technology in surveying to provide the basic map and spatial database for PROKLIM activity will be time consuming and less effective because PROKLIM database within ministerial website is online where data are needed be input quickly. Unmanned Aerial Vehicle (UAV) technology captures the image of the study area quickly and provides high resolution images. In addition, Avenza Maps application is available in Google Play Store and can be installed easily to assist the surveyor in mapping the locations of BIOPORI, TOGA and RIW. When combined together, UAV technology and online mapping can provide accurate and effective spatial database to support climate change readiness program in Depok Municipality.

This paper aims to provide spatial database and map of PROKLIM’s 3 activities, namely BIOPORI, TOGA and RIW in RW 10 Baktijaya Village using UAV and Avenza Maps application.

1.1. Study area
RW 10 in Baktijaya Village is located in Depok Municipality, West Java Province, Indonesia (Figure 1). It can be reach around 1 hour from Indonesia’s capital city, Jakarta. It has an area of approximately 44,100 m².

![Figure 1. Study Area](image)

2. Methods
Overall research framework can be observed in Figure 2. Firstly, interviews were performed with officers from Environmental and Cleaning Service Agency of Depok Municipality and the elderly from village to explore the boundary of RW 10 Baktijaya Village. Secondly, DJI Phantom 4 Pro was flown at 100 m height to take image of the study area. Captured image from UAV was processed using Agisoft Photoscan to generate image with RGB channels. Geometric correction for this image was performed with Google Earth image served as ground truth coordinates.
The boundary line of study area based on interviews then digitized as separate layer in existing image from UAV. Locations of BIOPORI, TOGA, and RIW were input into map using Avenza Map application. These 3 activities were converted into 3 GIS layers within ArcGIS environment. Resulted map was produced as a single map containing high resolution image from UAV with locations of BIOPORI, TOGA, and RIW.

Figure 2. Research framework

2.1. DJI Phantom 4 Pro specification

In this study, a DJI Phantom 4 Pro was flown at 100 m height above the study area. After geometric correction, image spatial resolution is 2.4 cm/pixel. Detail specifications of both UAV and camera can be seen in Table 1 and Table 2.

| UAV Specification (DJI, 2019) |
|-----------------------------|
| **Type** | Quadcopter |
| **Weight** | 1388 gram (with battery & propellers) |
| **Battery capacity** | 5870 mAh |
| **Remote Control Transmission Distance** | 3.5 km |
| **Flight Time** | Approx. 30 minute |
| **Speed** | 31 mph - 45 mph |
| **Wind Speed Resistance** | 10 m/s |

| Camera Specification (DJI, 2019) |
|-------------------------------|
| **Sensor** | 1"CMOS |
| **Lens** | FOV 84° 8.8 mm/24 mm |
| **Photo Format** | JPEG, DNG (RAW), JPEG + DNG |
2.2. UAV image processing

Image from UAV was processed using Agisoft Photoscan software. At first, image from UAV was imported and input in one project. To get initial 3D picture, align photos process was conducted. The next step was to make Dense Point Clouds. Dense Point Clouds is a group of elevation points in thousands or millions of point resulted from airborne image photogrammetry process. The main output of airborne photo in Agisoft Photoscan is Build Mesh. Similarly, model texture process functioned to see the physical 3D model from existing coverage area.

2.3. BIOPORI, TOGA, and RIW location mapping using Avenza Maps application

In this study, Avenza Maps application was chosen because it is available in Google Play store so that it can be used easily by its users. BIOPORI, TOGA, and RIW locations were pointed by the head of RW 10 Baktijaya Village and recorded spatially using Avenza Maps (Figure 3).

Figure 3. Steps of TOGA and BIOPORI locations input using Avenza Maps: (a) initial marking place of RW 10 Baktijaya Village, (b) ground truth observation of TOGA and BIOPORI locations, (c) input location data in the application

3. Results and Discussion

Locations of BIOPORI, TOGA, and RIW were successfully mapped using Avenza Maps application, and they were converted into shapefile file extension. These 3 layers then integrated with geo-referenced image from UAV.

For the final product of PROKLIM activities, all of those layers were integrated with UAV image. Hence, final map is shown in Figure 4 which includes all 3 activities of PROKLIM. This map was displayed to the team from MoEF during the first visit in RW 10 Baktijaya Village. When asked about the final map, officers from Depok Municipality Environment and Cleaning Agency were satisfied with the progress of PROKLIM activities mapping.

Visually, it can be observed that RIW are located near the mosque and soccer field within the centre of study area. On the other hand, BIOPORI and TOGA locations are stretched along the walkways when observed in Figure 4. For the stakeholders of PROKLIM, this situation gives the unbalance of activities locations where in the eastern part of the study area not so many houses are participating. Therefore this mapping can also direct the stakeholders to encourage more houses and people to be involved in the program especially in the eastern side of RW 10 Baktijaya Village.
4. Conclusion

The map of PROKLIM activities was successfully generated from UAV image and Avenza Maps application. Pre-processing steps and geometric correction should be performed to produce orthophoto image with spatial resolution of 2.4 cm/pixel. In addition, BIOPORI, TOGA, and RIW locations input in Avenza Maps are needed to be converted into shapefile extension for further analysis. However, the use of both UAV image and Avenza Maps provide high resolution image and accurate locations of PROKLIM activities in RW 10 Baktijaya Village.

In can be concluded that the combination of UAV image and Avenza Maps to produce PROKLIM activities map in RW 10 Baktijaya Village is successful, indicated by the generated high resolution image and precise locations.
References

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