

# Crop stage classification using supervised algorithm based on UAV and Landsat 8 image

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## Crop stage classification using supervised algorithm based on UAV and Landsat 8 image

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**Abstract.** Irrigated area has been decreasing since last decade in Indonesia. Surface irrigation scheduling performed predominantly due to water limitation and plant heterogeneity. Plant type and growth phase relate to the performance of water delivery. The research objective is to compare land use classification (LUC) from Landsat 8 and Unmanned Aerial Vehicle (UAV) with supervised algorithm. Supervised method (i.e. minimum distance algorithm) was applied. The result showed six LUC from UAV, i.e.: vegetative stage of dry crop (39%), ripening stage of dry crop (23%), vegetative stage of paddy (15%), tillage (15%), bare land (7%), and paddy nursery (6%). On the other hand, five LUC were performed by Landsat 8 image, i.e.: vegetative stage of dry crop (10%), ripening stage of dry crop (17%), vegetative stage of paddy (5%), tillage area (62%), bare land (6%). UAV's image source performed more detail and accurate than satellite image. Thus, supervised method appropriate for UAV image for crop stage classification in small irrigation district.

### 1. Introduction

Land use change (LUC) in agricultural sector (i.e. irrigated area) decreased slightly since last decade in Indonesia especially Java Island. Tarigan and Tukayo [1] reported of rice field reducing area around 9 ha since 2002 to 2009 in Northern Java coastal due to settlement expansion. Declining agricultural land is driven by external, internal and policy factor [2–4]. Significantly agriculture land degradation was reported in parts of Yogyakarta province due to price and location regarding conversion site [5]. Further, in parts of West Java, farmer capabilities, e.g. agricultural business experience and education level, drive agricultural conversion [2]. Each location characteristics driven on anxious agricultural land degradation differently especially on irrigated area of Java Island.

Nowadays, temporal and spatial variability of crop pattern occur in irrigated area [6, 7]. In Indonesia, planting period and pattern follow the rule of irrigation management before reformation era [8]. Limiting irrigated agricultural area, increasing farmer's knowledge and independence on plant cultivation make plant heterogeneity in one irrigation district [9, 10]. It effects the water scheduling as each plant stage need different water consumption. Thus, real time information of plant pattern and stage may improve the performance index of irrigation system.

UAV (*Unmanned Aerial Vehicle*) and satellite approaches have showed appropriate accuracy and a real time result. Identification of crop growth status and yield was conducted in mainland China by UAV technique and various regression models [11]. Understanding on crop phenotyping by UAV image analysis was confirmed in several studies [12]. On the other hand, satellite image have a benefit



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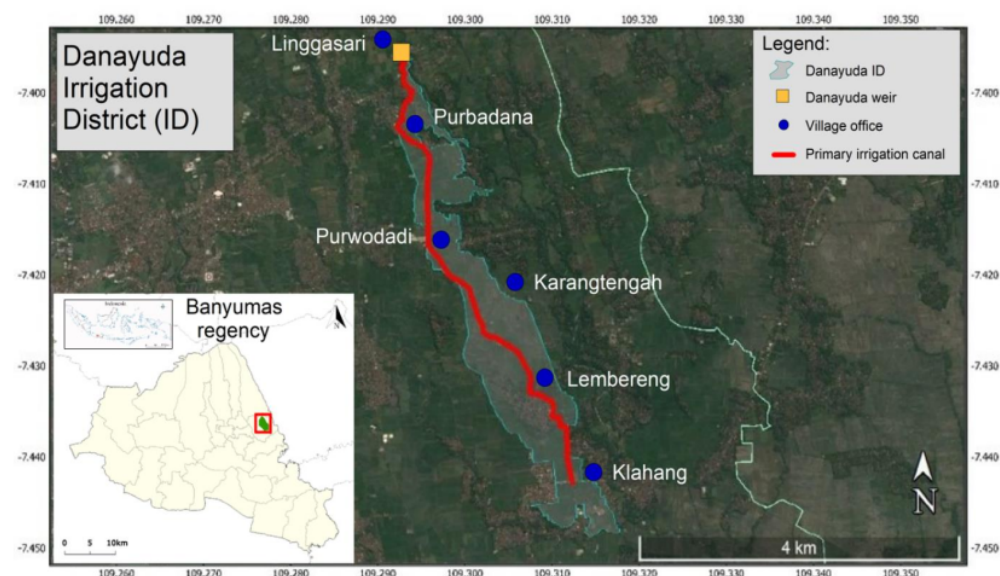
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for long term monitoring in an enormous area [13, 14]. Monitoring rice in mainland Asia using Landsat 8 demonstrated strong ability for assessing and monitoring rice production [15]. Based on UAV and satellite image analysis, comparing algorithm on plant stage classification will be conducted in this research area. Supervised algorithm (i.e. minimum distance) show decent result on plant classification. Thus, this research objective to compare results from both image sources (i.e. UAV and satellite image) with supervised algorithm classification method.

## 2. Research methods

### 2.1. Location

Spatial data collection was conducted in Danayuda Irrigation District (ID), Banyumas Regency, Central Java Province, Indonesia (Figure 1). Danayuda's primary canal spans seven villages, namely Linggasari, Purbadana, Purwodadi, Karangtengah, Lembereng, and Klahang villages sequentially from upstream to downstream. This irrigation system is authorized by Banyumas Government with around 350 ha of coverage area. Based on the precipitation, the farmers cultivate three times annually, i.e. growing season (GS) 1 (November-February; rainy season), GS 2 (March-June; partially rain-dry season), and GS 3 (July-October; dry season). Paddy and palawija are cultivated in GS 1-2 and GS 3, respectively. However, plant stage heterogeneity showed in each GS. We collected the data in the early GS 1 2019.



**Figure 1.** Research location (Danayuda irrigation district)

### 2.2. Data collection

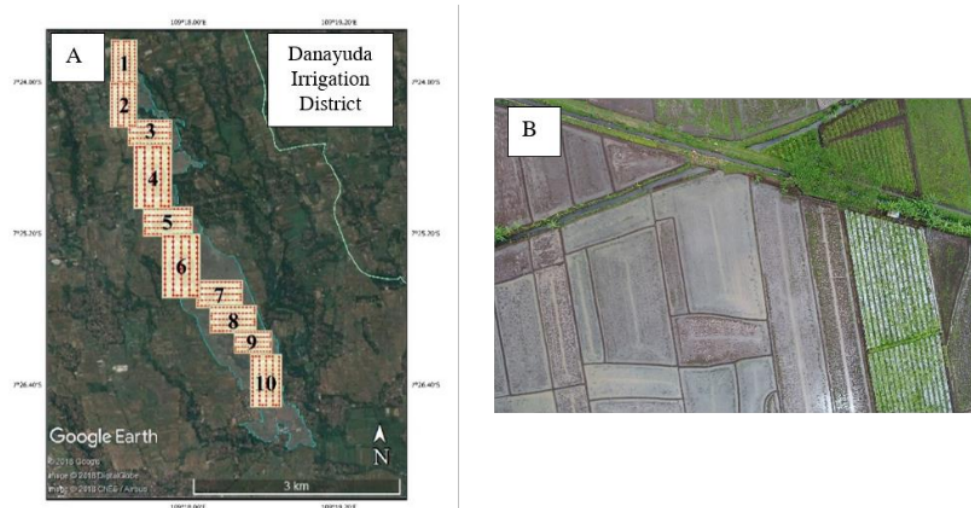
UAV's images were collected by DJI Phantom 4 Pro with Effective pixels 12.4 M. The drone captured object area with 10 back-forth missions, 100 m flight height, and perpendicular camera (Figure 2). Satellite imagery (i.e. Landsat 8) was retrieved from <http://earthexplorer.usgs.gov>. Both image data collections considered to have similar space and time.

### 2.3. Data analysis

Multiple raster datasets were merged by mosaicking process to obtain single raster dataset. We applied mosaicking process by Agisoft Photoscan, then classified raster dataset by supervised classification (i.e. minimum distance algorithm, (16)) by QGIS 2.18 version. Minimum distance algorithm derived Euclidean distance of each pixel distance regarding to each class (equation 1):

$$d(x, y)^2 = \sum_{i=1}^n (x_i - y_i)^2 \dots\dots\dots (\text{eq. 1})$$

where:  $x$ = spectral point vector of an image pixel;  $y$ = spectral point vector of training area,  $n$ = number of image bands, and  $d(x, y)$ = Euclidian distance. We classified six classes of crop stage, namely: growth stage of palawija crop (gp), harvesting stage of palawija (hp), vegetation stage of rice (vr), tillage (t), seedling (s), and bare (b). Classification accuracy assessment compared with UAV's manual digitation of the three spots with equipped land use classes [17].

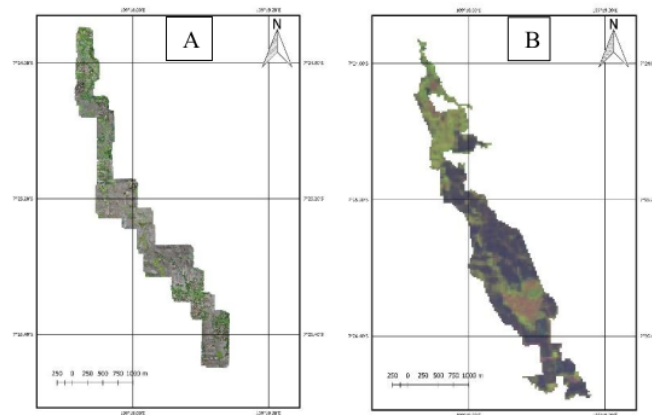


**Figure 2.** Drone mission of targeted area (A) and sample single picture with 100 m height-flight (B)

### 3. Results and discussion

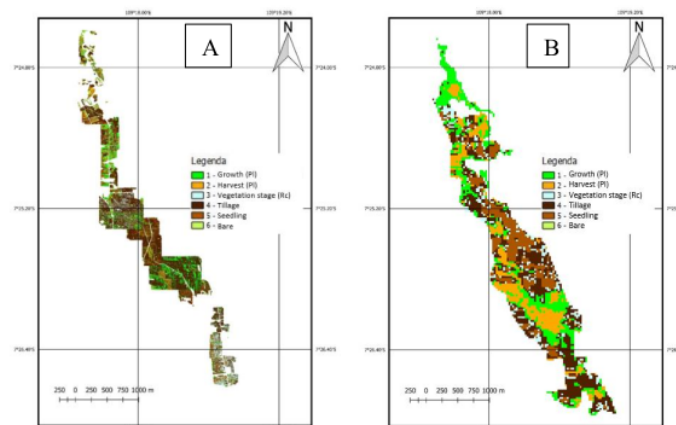
Danayuda Irrigation District consists not only agriculture field but also settlement and home garden. Agriculture irrigated area is around 176.3 ha. Various agricultural function were displayed in this area, however, the data were set in GS 1. Mosaicking single raster data set from UAV (Figure 3A) and Landsat 8 (Figure 3B) images performed clear result. Environmental factors, e.g. wind speed, cloud, and temperature, influenced the image quality and accuracy of both image source. In addition, UAV's image was also influenced by technical factors such as camera certification, flight altitude, and UAV's stability [18, 19]. Lee and Sung [20] performed consistent image quality with 130 and 260 m UAV's flight altitude but Lim et al. [19] suggested 30-80 m altitude. Accordingly, we operated UAV on 100 m of height.





**Figure 3.** Mosaicking raster data set of Danayuda ID from UAV's image (A) and Landsat 8 band agriculture (B) image.

Six and five classes were determined concerning to UAV's and Landsat image, respectively. Seedling crop phase was not noticed in Landsat 8 image as the quality image was poor. Our research compared similar algorithm in crop stage classification from both source. UAV's image is suitable for small scale classification of spatial variability (Figure 4a). Each class was showed more precise class identification than satellite image (Figure 4b). We were not comparing dynamic data set, however, Berra et al. [21] suggested to use satellite data set for ecosystem dynamic study and UAV's image data set for tracking individual tree. Furthermore, some research used UAV's images for confirming from satellite imagery with 87-88% accuracy [22, 23].



**Figure 4.** Crop stage classification based on UAV's (A) and Landsat 8 images (B). Minimum distance algorithm was applied for both.

The three representative UAV's missions performed different result of classification (Table 1). However, complete classification was performed by UAV's image source. Both results were compared to ground check investigation. The different result of classification between UAV's and Landsat

images could occur due to the specification and technical limit (24). Landsat image is appropriate on dataset monitoring periodically but has poor pixel. Thus, several crop stages cannot be classified from Landsat image. In precision of water delivery of District Irrigation, UAV's image is more appropriate to resulting detail information of crop phenology due to highly detailed images [24, 25].

**Table 1.** Comparing crop stage classification from ground (G), UAV's (U), and Landsat 8 (L)

No	Class	HM 0-7 mission			HM 10-16 mission			HM 17-25 mission		
		G (ha)	U (ha)	L (ha)	G (ha)	U (ha)	L (ha)	G (ha)	U (ha)	L (ha)
1	Growth (Pl)	2.4	1.4	NA	0.4	0.3	NA	1.7	2.7	0.2
2	Harvest (Pl)	1.3	1.2	2.8	0.6	0.9	1.5	3.4	1.4	NA
3	Veg. (Rc)	0.2	0.7	N/A	0.7	1.3	NA	0.1	0.3	NA
4	Tillage	1.9	3.3	N/A	2.1	2.2	3.2	1.1	2.4	0.2
5	Seedling	0.1	1.3	3.0	0.1	0.2	NA	0.1	0.9	NA
6	Bare	3.6	1.8	2.2	1.1	0.2	NA	2.5	1.2	8.4

#### 4. Conclusion

Data collection performed in the early first of cultivation period (i.e. GS 1). Danayuda Irrigation area (potentially) consist of around 50.3% irrigation area and other functions (settlement, home garden, bare land, etc). Based on imagery sources with supervised algorithm approach: UAV data set performed (six classification of vegetation cover) and Landsat 8 image performed (five classification of vegetation cover). Based on imagery source: UAV data set was more detail and accurate on classification than Landsat 8.

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#### References

- [1] Darma T S and Tukayo R K 2013 *J Trop Soils* **18** 8
- [2] Naura A, Sulistyowati L and Karmana M H 2020 *Social Science and Humanities Journal* **4** 11
- [3] Rondhi M, Pratiwi P, Handini V, Sunartomo A and Budiman S 2018 *Land* **7** 148
- [4] Handayani S W, Kunarti S and Supriyanto 2018 *The Dynamics of Paddy Land Legal Policy in Indonesia SHS Web Conf.* **54** 03009
- [5] Harini R and Yunus H S 2012 *Indonesian Journal of Geography.* **44** 120–133
- [6] Uchida S 2010 *Remote Sensing and Spatial Information Science.* **38** 477–481
- [7] Pasandaran E 2010 *ICID – CIID Seminar on History of Irrigation in Eastern Asia*, Yogyakarta, Indonesia.
- [8] Pasandaran E 2004 *Jurnal Litbang Pertanian* **23** 82 – 90
- [9] Sianturi R and Jetten V 2018 *International Journal of Disaster Risk Reduction* **28** 335–49
- [10] Pasaribu S M and Routray J K 2005 *International Journal of Water Resources Development* **21** 473–491
- [11] Wang Y, Zhang K, Tang C, Cao Q, Tian Y and Zhu Y 2019 *Remote Sensing* **11** 1371
- [12] Yang G, Liu J, Zhao C, Li Z, Huang Y and Yu H 2017 *Front Plant Sci.* **8** 1111
- [13] Sari D K, Ismullah I H, Sulasdi W N and Harto A B 2010 *ITB J. Sci.* **42** 91-106
- [14] Supriatna S 2019 *Geomate* **17**

- [15] Torbick N, Chowdhury D, Salas W and Qi J 2017 *Remote Sensing* **9** 119
- [16] Murtaza K O and Romshoo S A 2014 *International Journal of Geomatics and Geosciences* **4** 16
- [17] Erbek F S, Özkan C and Taberner M 2004 *International Journal of Remote Sensing* **25** 1733–48
- [18] Song B and Park K 2020 *Remote Sensing* **12** 288
- [19] Lim P-C, Kim T, Na S-I, Lee K-D, Ahn H-Y and Hong J 2018 *Int Arch Photogramm Remote Sens Spatial Inf Sci* **4** 359–64
- [20] Lee J and Sung S 2016 *Spat Inf. Res.* **24** 141–54
- [21] Berra E F, Gaulton R and Barr S 2019 *Remote Sensing of Environment.* **223** 229–42
- [22] Marx A, McFarlane D and Alzahrani A 2017 *International Journal of Remote Sensing* **38** 2331–48
- [23] Murugan D, Garg A and Singh D 2017 *IEEE J. Sel. Top. Appl. Earth Observations Remote Sensing* **10** 5322–8
- [24] Lukas V, Novák J, Neudert L, Svobodova I, Rodriguez-Moreno F and Edrees M 2016 *Int. Arch Photogramm Remote Sens Spatial Inf Sci.* **8** 953–7
- [25] Simic M A, Romanko M, Reil P, Abeysinghe T, Marambe A 2018 *International Journal of Remote Sensing* **39** 5415–31



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