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

A Hardanto[1], Ardiansyah[1] and A Mustofa[1]

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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.

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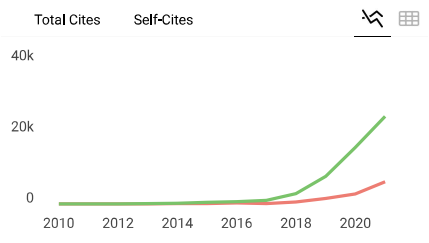

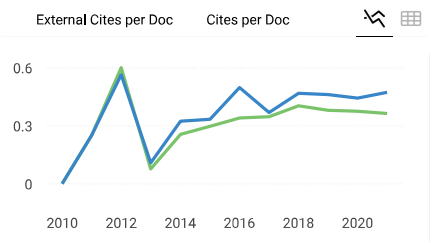

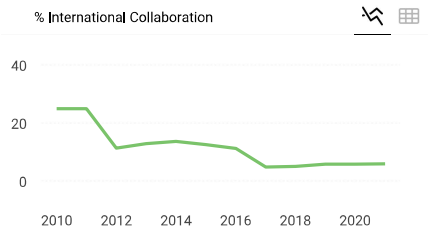

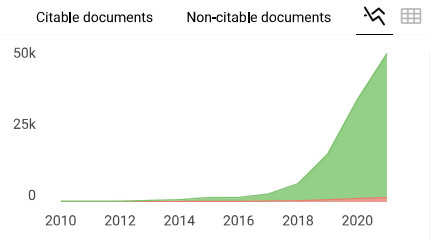

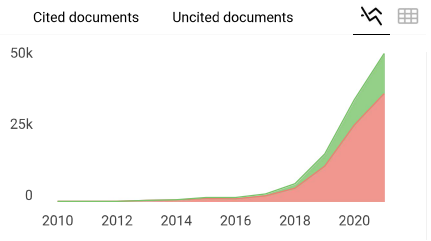

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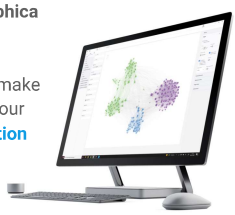

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kind regards

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Melanie Ortiz 1 month ago

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The Scopus' update list can also be consulted here:
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A **Alharia Dinata** 1 year ago

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V **Vani** 1 year ago

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Melanie Ortiz 2 years ago

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Please help me to resolve the issue. Thank you for your kindness. I am waiting for good news from you.

Sincerelly,
Mursalin

reply

SCImago Team

Melanie Ortiz 3 years ago

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N **Танзиля Созаева** 3 years ago

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reply

SCImago Team

Melanie Ortiz 3 years ago

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S **syaiful** 4 years ago

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best regards

syaiful

reply

SCImago Team

Elena Corera 4 years ago

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

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

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Faculty of Agriculture, Jenderal Soedirman University, Jl. Dr. Soeparno No. 63, Purwokerto 53122, Indonesia

Corresponding author: hardanto.unsoed@gmail.com

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 Northem 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.

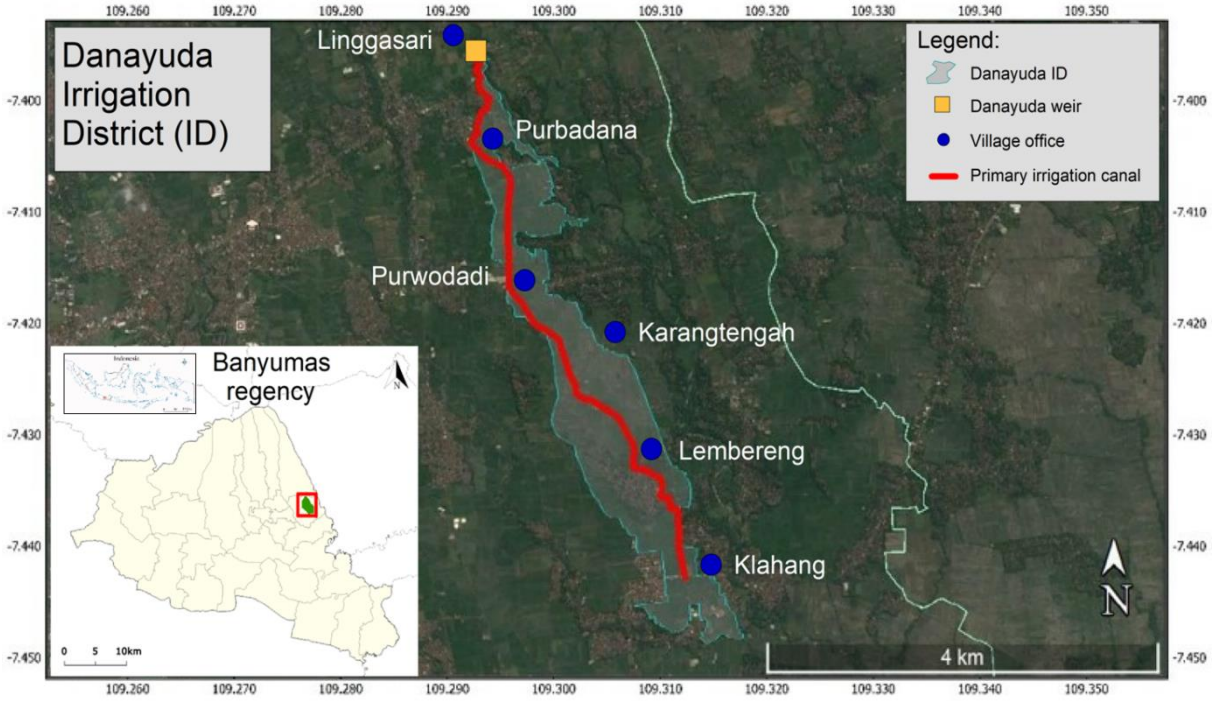
UAV *(Unmanned Aerial Vehicle)* and satellite approaches have showed appropriate accuracy and a real time result. Identification of crop growth status and yield was conducted in mainland China by UAV technique and various regression models 11). Understanding on crop phenotyping by UAV image analysis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

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.



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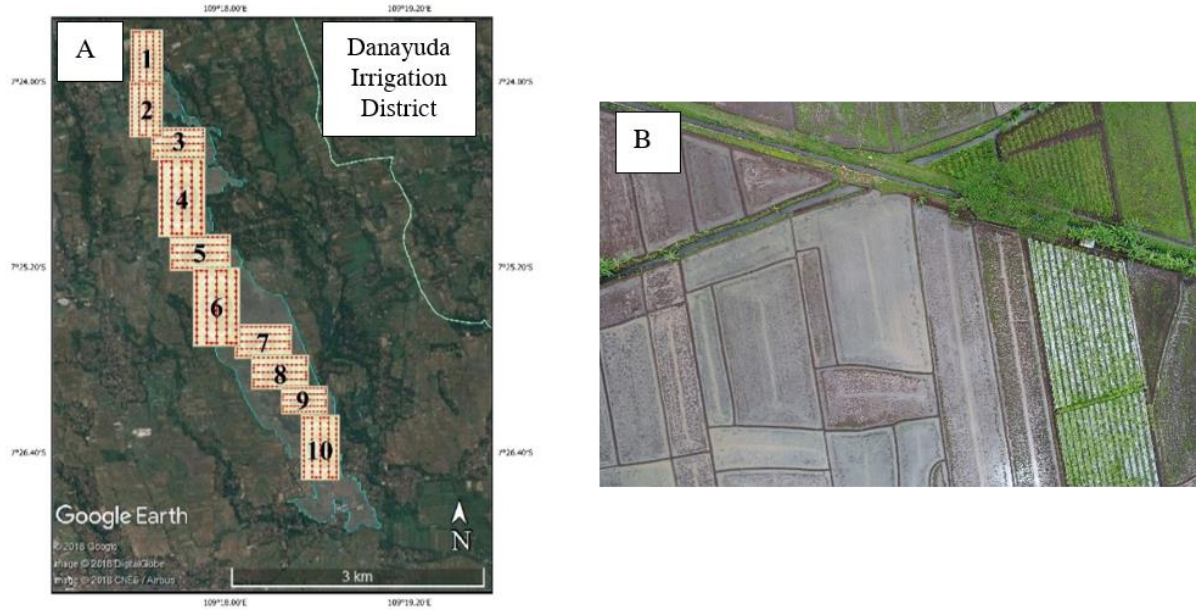
$$d\,(x,y)^2 = \sum_{i=1}^{n}(x_i - y_i)^2 \quad \text{..... (eq. 1)}$$

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].



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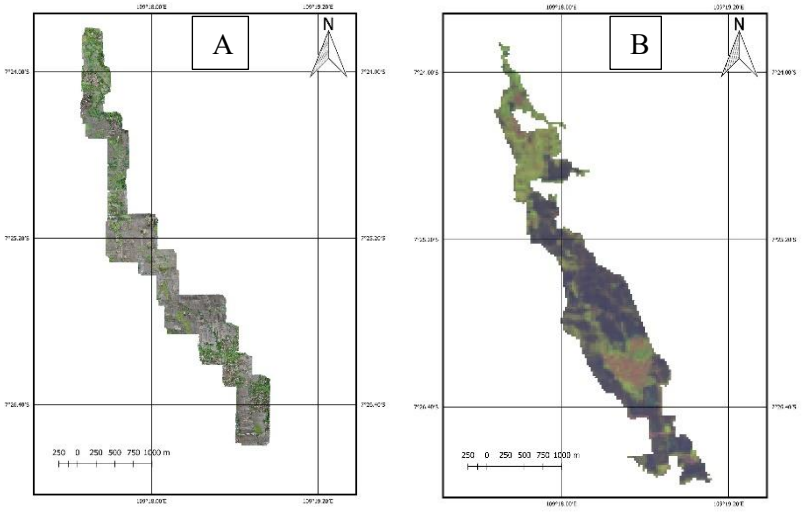

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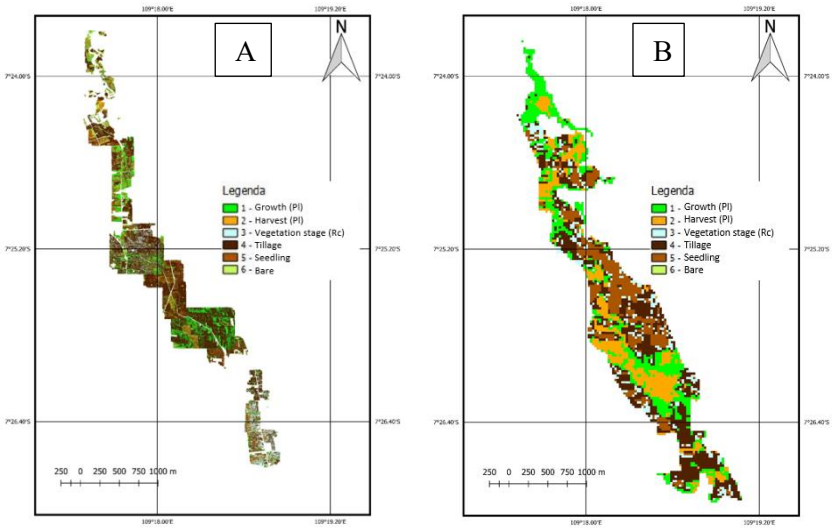
Six and five classes were determined concerning to UAV's and Landsat image, respectively. Seedling crop phase was not noticed in Landsat 8 image as the quality image was poor. Our research compared similar algorithm in crop stage classification from both source. UAV's image is suitable for small scale 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].



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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.

Acknowledgement

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

by Ardiansyah Ardiansyah

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

A Hardanto*, Ardiansyah and A Mustofa

Faculty of Agriculture, Jenderal Soedirman University, Jl. Dr. Soeparno No. 63, Purwokerto 53122, Indonesia

Corresponding author: hardanto.unsoed@gmail.com

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 Northem 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.

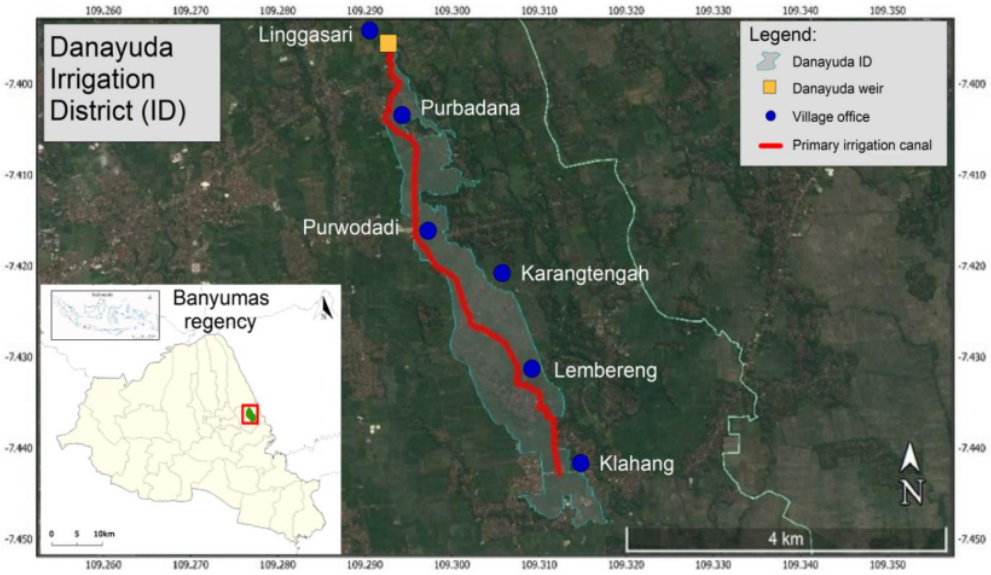
UAV *(Unmanned Aerial Vehicle)* and satellite approaches have showed appropriate accuracy and a real time result. Identification of crop growth status and yield was conducted in mainland China by UAV technique and various regression models 11). Understanding on crop phenotyping by UAV image analysis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

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.



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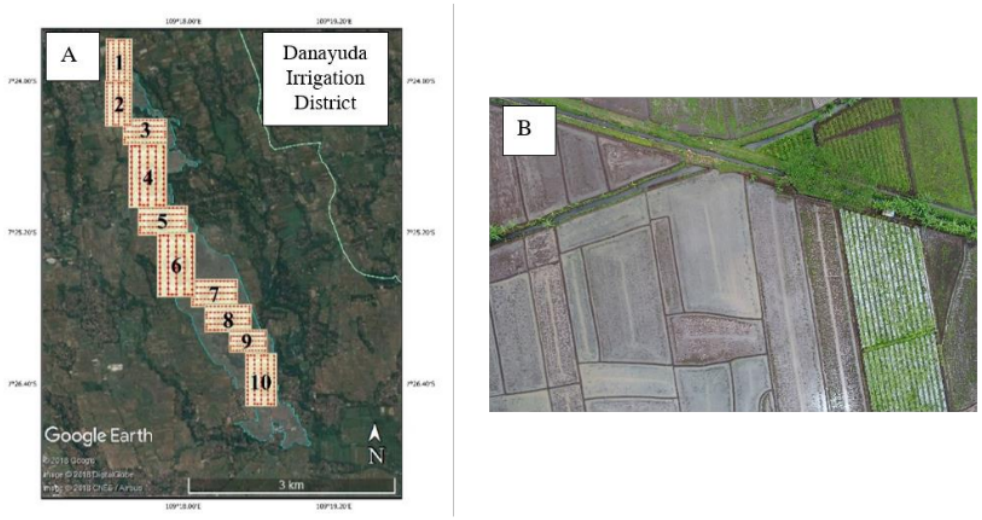

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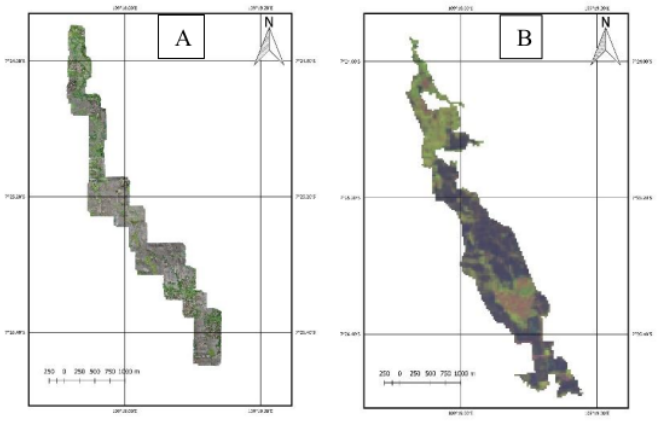

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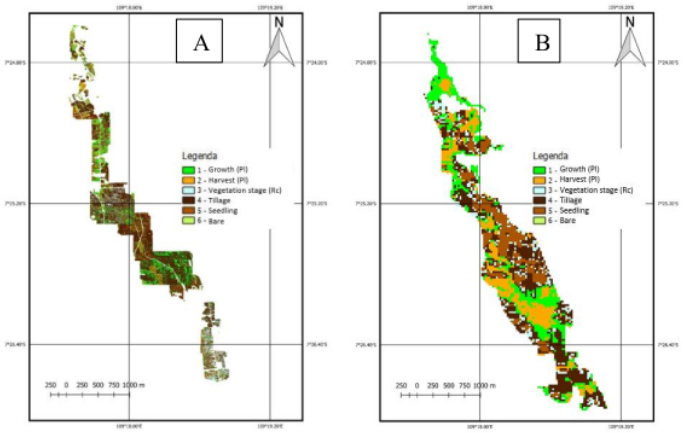

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as

Presenter

Faculty of Agriculture | **Universitas Jenderal Soedirman**

Purwokerto, **October 20th 2020**

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LETTER OF ACCEPTANCE

October 5, 2020

Dear Afik Hardanto

The organizing committee of the 2nd International Conference on Sustainable Agriculture for Rural Development (2nd ICSARD) 2020 is pleased to inform you that the submitted abstract entitled:

Crop Stage Classifiaction using Supervised Algorithm Based On UAV and Landsat 8 Image

has been accepted for Oral Presentation based on the peer-review by the scientific committee of 2nd ICSARD, which will be held virtually on October 20, 2020. The abstract will be appeared in the book of program and will be available for all participants of the conference. We would like to thank for your contribution in the 2nd ICSARD 2020 and look forward to your participation in this event.

Best regards,

Susanto Budi Sulistyo, PhD.
Chairman of 2nd ICSARD Committee

Book of Program

OCTOBER 20th
2020

The 2nd International Conference on Sustainable Agriculture for Rural Development (ICSARD)

Organized by :

Faculty of Agriculture
Universitas Jenderal Soedirman

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The 2nd International Conference on Sustainable Agriculture for Rural Development 2020 is organized by the Faculty of Agriculture, Jenderal Soedirman University.

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Indonesia

Conference Report by the Chairman

Assalamu'alaikum warahmatullahi wabarakatuh
Good morning

The honorable Rector of Jenderal Soedirman University or his representative,
The honorable deans of all faculties in Jenderal Soedirman University,
The honorable invited speakers,
And all distinguished participants,

Ladies and gentlemen,
On behalf of the Organizing Committee, I am honored and delighted to welcome you to the official opening of the 2nd International Conference on Sustainable Agriculture for Rural Development 2020 which is held virtually due to the pandemic of COVID-19.

This conference is organized by the Faculty of Agriculture, Jenderal Soedirman University and is a part of the event series to celebrate the 58th Anniversary of the Faculty of Agriculture, Jenderal Soedirman University. This one-day seminar comprises both plenary and parallel session. In the plenary session there are three invited speakers who will give presentations and share their knowledge and expertise. I would like to express my sincere gratitude to all invited speakers, Prof. Ting-ting Wu, Ph.D. from National Yunlin University of Science and Technology, Taiwan, Prof. Tatsuo Sato, Ph.D. from Ibaraki University, Japan, and Suprayogi, Ph.D. from Jenderal Soedirman University, Indonesia, who have accepted our invitation.

Ladies and gentlemen,
We have accepted 207 abstracts from researchers who will present their most recent research in the parallel session. Participants are mostly from Indonesia and also from abroad, i.e. Japan, Vietnam, Sudan, Oman, Iraq, and New Zealand. We hope that this virtual conference will provide a perfect forum for participants to interact and possibly discuss future collaborations.

As a general chair of this conference, I realize that the success of the conference depends ultimately on many people who have worked with us in planning and organizing both the technical program and supporting social arrangements. I would like to thank all committee members who have worked extremely hard for the details of important aspects of the conference programs.

We hope that you will experience a fruitful and inspiring meeting and leave this virtual conference with enlarged horizons for research and education perspectives.

Thank you.
Wassalamu'alaikum warahmatullahi wabarakatuh

Susanto B. Sulistyo, Ph.D.
Chairman of the 2nd ICSARD 2020

PARALLEL SESSION (Room: ABE 1)

Session 1 (13.00 – 15.00)					
Moderator		Ardiansyah, S.TP., M.Si., Ph.D.			
Notulen		Dian Novitasari, S.TP., M.Si.			
No	Time	Paper ID	Title	Authors	Affiliation
1.	13.00-13.10	657	Design of Handheld Arduino-based Near Infrared Spectrometer for Non-Destructive Quality Evaluation of Siamese Orange	Susanto B. Sulistyo, Siswantoro, Agus Margiwiyatno, Masrukhi, Asna Mustofa, Arief Sudarmaji, Rifah Ediati, Riana Listanti, and Hety Handayani Hidayat	Agricultural Technology Department, Faculty of Agriculture, Jenderal Soedirman University, Indonesia
2.	13.10-13.20	887	Papaya Fruit Characters Based Selection on New Superior Variety Assembly Program to Improve Health and Consumption	Tri Budiyanti, Noflindawati , Riry Prihatini, and Dewi Fatria	Indonesian Tropical Fruit Research Institute, Jalan Raya Solok-Aripan km.8 Solok 27301, West Sumatra, Indonesia
3.	13.20-1330	914	The Addition of Biosilica and Coconut Oil to Improve the Characteristic of Biofoam Packaging	Kendri Wahyuningsih, Evi Savitri Iriani, and Bunda Amalia	Badan Penelitian dan Pengembangan Pertanian, Ministry of Agriculture, Indonesia
4.	13.30-13.40	927	Optimization of Tapping Time, Duration and Addition of Natural Preservation (Laru) for Quality Control of Coconut SAP	Mustaufik, Lilik Sutiarso, Kuncoro Harto Wododo, and Sri Rahayoe	Food Technology Department, Faculty of Agriculture, Jenderal Soedirman University, Indonesia
5.	13.40-13.50	936	Development Potential of Multi Purpose Trees Special (MPTS) Area In Northern Bandung as An Alternative for Sustainable Land Use in The Upstream Area	Bambang Susanto, Hendi Supriyadi, and Yanuar Argo	West Java Assessment Institute for Agricultural Technology
6.	13.50-14.00	942	Application of Soil Water Assessment Tool (SWAT) in Selopamioro Catchment for Determining Soil and Water Conservation Strategy	H Habib, Ngadisih, R Tirtalistyani, S Susanto	Department of Agricultural and Biosystem Engineering Faculty of Agricultural Technology Universitas Gadjah Mada

No	Time	Paper ID	Title	Authors	Affiliation
7.	14.00-14.10	979	The Relationship of Soil Nitrate Distribution and Growth Rate of Capsicum frutescens in Subsurface Flow Constructed Wetland integrated with Household Septic Tank	Yudha Dwi Prasetyatama, Ngadisih, Rizki Maftukhah, Rudiati Evi Masithoh, J.N.W. Karyadi, and Lilik Soetiarso	Universitas Gadjah Mada, Indonesia
8.	14.10-14.20	981	Kinetics Analysis of The Effect of Types and Concentrations of Ripening Agents on The Physical Quality Changes of Banana Fruit (Musa acuminata Colla)	Ahmad Khairuddin and Nursigit Bintoro	Department of Agricultural Engineering and Biosystem, Faculty of Agricultural Technology, Gadjah Mada University, Indonesia
9.	14.20-14.30	991	Equilibrium and Kinetic Studies of Methylene Blue Biosorption by Sugar Plam Dregs	Hisyam Musthafa Al Hakim and Wahyu Supartono	Doctoral Student at Gadjah Mada University, Indonesia
10.	14.30-14.40	1037	Application of Spectroscopy Fourier Transform Near-Infrared (FT-NIR) For Detection Adulteration in Palm Sugar	Kunti Rismiwandira, Ferini Roosmayanti, M Fahri Reza Pahlawan, and Rudiati Evi Masithoh	Department of Agricultural and Biosystems Engineering, Faculty of Agricultural Technology, Universitas Gadjah Mada, Indonesia
11.	14.40-14.50	1198	Crop Stage Classification Using Supervised Algorithm based on UAV and Landsat 8 Image	A Hardanto, Ardiansyah, and A Mustofa	Faculty of Agriculture, Jenderal Soedirman University, Indonesia
12.	14.50-15.00	1102	Evaluation of The Flushing Efficiency of The Pengasih Weir Sand Trap, Special Region of Yogyakarta	Ansita Gupitakingkin Pradipta, Gina Isna Nafisa, Murtiningrum, Chandra Setyawan, and Sigit Supadmo Arif	Department of Agricultural and Biosystems Engineering, Faculty of Agricultural Technology, Universitas Gadjah Mada, Indonesia