

user can analyze the spatial surface of the plot very clearly. The spatial resolution was 1.43 cm and suitable for rice monitoring since the plant was still small and at the young age. Results identify the uneven ground surface in the plot area. The poor irrigation system in the plot is also one of the factors contributing to the decreasing yield since at the beginning the management seems to be not well prepared. It will affect the plant condition and the rice production. It shows clearly that the water flow of the low surface. This will waste the input and some of the parts were not enough nutrient because of the high surface.

Therefore, the information was important to monitor the development of growth for the paddy field was in a good condition. All this information was beneficial for farmers in their management system. It can be a reference for the decision marker and action plan to improve the development growth of the rice plants. Thus, the preparation of the plot in the rice field needs to be prepared before the seeds are planted to make sure the condition of the soil is in a good condition. UAV helps a lot in monitoring the whole area at low cost and the data can be used for the further analysis and action plan for the future.

ACKNOWLEDGMENT

This research was supported by the Ministry of Higher Education (MOHE) through Fundamental Research Grant Scheme (FRGS/1/2020/ICT02/UTHM/02/1). The authors would like to gratefully thank all the participants of this study for their help and cooperation.

REFERENCES

- [1] P. Mehra, S. S. Patel, B. L. Kumhar, and S. Jain, "Precision Agriculture: An Approach to Farm Management."
- [2] S. Chakane, H. Chaskar, P. Patil, P. Shelar, and P. Godse, "Automated Information System for Improved Crop Management," *International Journal of Agriculture Innovations and Research*, vol. 740, 2017.
- [3] D. C. Rose, R. Wheeler, M. Winter, M. Lobley, and C.-A. Chivers, "Agriculture 4.0: Making it work for people, production, and the planet," *Land Use Policy*, vol. 100, p. 104933, 2021.
- [4] I. Cisternas, I. Velásquez, A. Caro, and A. Rodríguez, "Systematic literature review of implementations of precision agriculture," *Computers and Electronics in Agriculture*, vol. 176, p. 105626, 2020/09/01/ 2020.
- [5] N. N. Che'Ya, "Site-Specific Weed Management Using Remote Sensing," 2016.
- [6] K. Manjunath, R. S. More, N. Jain, S. Panigrahy, and J. Parihar, "Mapping of rice-cropping pattern and cultural type using remote-sensing and ancillary data: a case study for South and Southeast Asian countries," *International Journal of Remote Sensing*, vol. 36, no. 24, pp. 6008-6030, 2015.
- [7] S. K. Seelan, S. Laguetta, G. M. Casady, and G. A. Seielstad, "Remote sensing applications for precision agriculture: A learning community approach," *Remote sensing of environment*, vol. 88, no. 1-2, pp. 157-169, 2003.
- [8] A. Knierim, M. Kernecker, K. Erdle, T. Kraus, F. Borges, and A. Wurbs, "Smart farming technology innovations—Insights and reflections from the German Smart-AKIS hub," *NJAS-Wageningen Journal of Life Sciences*, vol. 90, p. 100314, 2019.
- [9] Y. Rajamoorthy and S. Munusamy, "Rice industry in Malaysia: Challenges, policies and implications," *Procedia Economics and Finance*, vol. 31, pp. 861-867, 2015.
- [10] S. Mustaffha, S. K. Bejo, and W. I. W. Ismail, "CAFEi2012-74 Artificial Neural Network in Predicting Rice Yield," in *International Conference on Agricultural and Food Engineering for Life (Cafei2012)*, 2012, vol. 26, p. 28.
- [11] C. Siwar, N. D. M. Idris, M. Yasar, and G. Morshed, "Issues and challenges facing rice production and food security in the granary areas in the East Coast Economic Region (ECER), Malaysia," *Research Journal of Applied Sciences, Engineering and Technology*, vol. 7, no. 4, pp. 711-722, 2014.
- [12] M. Hossain and K. Fischer, "Rice research for food security and sustainable agricultural development in Asia: achievements and future challenges," *GeoJournal*, vol. 35, no. 3, pp. 286-298, 1995.
- [13] C. P. Timmer, "The changing role of rice in Asia's food security," 2010.
- [14] C. P. Timmer, "Food Security in Asia and the Pacific: The Rapidly Changing Role of Rice," *Asia & the Pacific Policy Studies*, vol. 1, no. 1, pp. 73-90, 2014.
- [15] N. Bandumula, "Rice production in Asia: Key to global food security," *Proceedings of the National Academy of Sciences, India Section B: Biological Sciences*, vol. 88, no. 4, pp. 1323-1328, 2018.
- [16] T. Sivasankar, D. Kumar, H. S. Srivastava, and P. Patel, *Advances in Radar Remote Sensing of Agricultural Crops: A Review* (2018, no. 4). 2018.
- [17] R. Zhao, Y. Li, and M. Ma, "Mapping paddy rice with satellite remote sensing: a review," *Sustainability*, vol. 13, no. 2, p. 503, 2021.
- [18] S. Oimbe, R. Ingle, and R. Awale, "Detection of soil water content using continuous wave ground penetrating radar," *JOIV: International Journal on Informatics Visualization*, vol. 2, no. 1, pp. 44-50, 2018.
- [19] W. Widiyatmoko, - Sudibyakto, E. Nurjani, and E. W. Safriani, *Spatial-Temporal Patterns of Agricultural Drought in Upper Progo Watershed Based on Remote Sensing and Land Physical Characteristics* (2019, no. 2). 2019.
- [20] C. Norasma *et al.*, "Rice crop monitoring using multirotor UAV and RGB digital camera at early stage of growth," in *IOP Conference Series: Earth and Environmental Science*, 2018, vol. 169, no. 1, p. 012095: IOP Publishing.
- [21] M. Y. Abu Sari, "Large Scale Topographic Map Comparison Using Unmanned Aerial Vehicle (UAV) Imagers and Real Time Kinematic (RTK)," *International Journal of Advanced Trends in Computer Science and Engineering*, vol. 9, pp. 328-338, 02/15 2020.
- [22] M. Y. A. Sari *et al.*, "3D mapping based-on integration of UAV platform and ground surveying," *Journal of Advanced Computer Science and Applications*, vol. 9, no. 12, pp. 160-168, 2018.
- [23] H. N. M. Shah *et al.*, "Design and develop an autonomous UAV airship for indoor surveillance and monitoring applications," *JOIV: International Journal on Informatics Visualization*, vol. 2, no. 1, pp. 1-7, 2018.
- [24] R. Binte Mostafiz, R. Noguchi, and T. Ahamed, "Agricultural Land Suitability Assessment Using Satellite Remote Sensing-Derived Soil-Vegetation Indices," *Land*, vol. 10, no. 2, p. 223, 2021.
- [25] A. Y. Chen, Y.-N. Huang, J.-Y. Han, and S.-C. J. Kang, "A review of rotorcraft unmanned aerial vehicle (UAV) developments and applications in civil engineering," *Smart Struct. Syst*, vol. 13, no. 6, pp. 1065-1094, 2014.
- [26] M. De Biasio, T. Arnold, R. Leitner, G. McGunnigle, and R. Meester, "UAV-based environmental monitoring using multi-spectral imaging," in *Airborne Intelligence, Surveillance, Reconnaissance (ISR) Systems and Applications VII*, 2010, vol. 7668, p. 766811: International Society for Optics and Photonics.
- [27] D. C. Tsouros, S. Bibi, and P. G. Sarigiannidis, "A review on UAV-based applications for precision agriculture," *Information*, vol. 10, no. 11, p. 349, 2019.
- [28] P. Radoglou-Grammatikis, P. Sarigiannidis, T. Lagkas, and I. Moscholios, "A compilation of UAV applications for precision agriculture," *Computer Networks*, vol. 172, p. 107148, 2020.
- [29] C. A. Rokhmana, "The potential of UAV-based remote sensing for supporting precision agriculture in Indonesia," *Procedia Environmental Sciences*, vol. 24, pp. 245-253, 2015.
- [30] M. Ozdogan, Y. Yang, G. Allez, and C. Cervantes, "Remote sensing of irrigated agriculture: Opportunities and challenges," *Remote sensing*, vol. 2, no. 9, pp. 2274-2304, 2010.
- [31] N. A. Sari, M. A. Sari, A. Ahmad, S. Sahib, and F. Othman, "Using LAPER quadcopter imagery for precision oil palm geospatial intelligence (OP GeoInt)," *Journal of Telecommunication, Electronic and Computer Engineering (JTEC)*, vol. 10, no. 1, pp. 25-33, 2018.
- [32] S. Shibusawa, "Precision farming approaches for small scale farms," *IFAC Proceedings Volumes*, vol. 34, no. 11, pp. 22-27, 2001.