

**COMPREHENSIVE SEMESTRAL REPORT ON THE FIELD PRACTICE AT
THE PHILIPPINE-SINO CENTER FOR AGRICULTURAL
TECHNOLOGY (PhilSCAT)**

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An Undergraduate Field Practice Manuscript Submitted to the Faculty of the Department
of Agricultural and Biosystems Engineering, College of Engineering, Central Luzon
State University, Science City of Muñoz, Nueva Ecija, Philippines
in Partial fulfillment of the requirements
for the degree of

**BACHELOR OF SCIENCE IN AGRICULTURAL AND BIOSYSTEMS
ENGINEERING
(AB Agricultural Mechanization and Renewable Energy)**

JULY 2024

ACCEPTANCE SHEET

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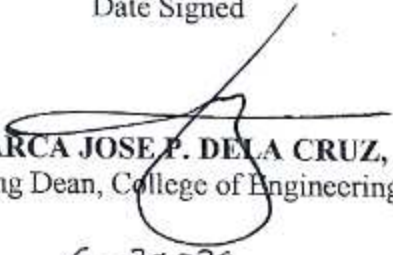

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BIOGRAPHICAL SKETCH

The author, Aries Jan Cuaresma Avellaneda, was born on January 1, 1998, in Casiguran, Aurora. He is the youngest child of Danilo R. Avellaneda and Esmeralda C. Avellaneda. He has seven siblings, Donbismarck C. Avellaneda, Haiziel C. Avellaneda, Bjay C. Avellaneda, Neil C. Avellaneda, Joycee C. Avellaneda and Dave Brian C. Avellaneda.

His first six years of education were spent at Dinalungan Central School in Poblacion, Zone 2 Dinalungan, Aurora. He graduated with high honor from primary school. He then continued his schooling at Juan Castillo Angara Memorial National High School, where he actively participated in various school events and joined various student organizations. During his senior year of high school, he was elected vice president of the Supreme Student Government and graduated as with high honor of his class.

The author exhibited a strong passion for agriculture from an early age. His innate curiosity and drive for knowledge led him to pursue higher education at Central Luzon State University, where he enrolled in the Agricultural and Biosystems Engineering program with a focus on Agricultural Power, Energy, and Machinery Engineering. Throughout his academic journey, the author has demonstrated exceptional dedication, continually seeking opportunities to expand his practical skills and deepen his theoretical understanding.

The author is a motivated and committed individual who has successfully completed an undergraduate field practice experience. The author's work signifies his potential to excel in his field, contribute to its advancement, and make a positive impact in his future endeavors as a professional practitioner or researcher

ACKNOWLEDGEMENT

The author would like to express his deepest gratitude to all those who have supported and contributed to the completion of this field practice program.

First and foremost, He is sincerely thankful to his adviser, Engr. May Cabral, whose guidance, expertise, and invaluable insights have been instrumental in shaping this work. Also to and Engr. Nicasio Salvador Dr. Marvin Cinense, members of the advisory committee; their unwavering support and constant encouragement have motivated me to push beyond my limits and strive for excellence.

He is also grateful to the faculty members of the Department of Agricultural and Biosystems Engineering, whose knowledge and expertise have been a constant source of inspiration throughout my academic journey. Their dedication to teaching and research has greatly enriched my understanding and passion for agricultural power, energy, and machinery engineering.

He would like to extend his appreciation to my friends and family for their unwavering support and encouragement. To my parents, Esmeralda and Danilo, their belief in his and their understanding during the challenging moments have been his driving forces. Their words of encouragement and love have sustained me throughout this endeavour.

In addition, he would like to acknowledge our immediate supervisors, Sir. Danilo Macato and Engr. Edgardo Coloma, who professionally guided us and generously gave their time and shared their insights for the purpose of this study. Also to the PhilSCAT staff, especially the ABED family, who welcomes us wholeheartedly. Without their cooperation and contributions, this research would not have been possible.

Furthermore, he would like to express his gratitude to the countless individuals who have contributed to the advancement of knowledge in his field. Their groundbreaking work and publications have provided the foundation upon which this research is built.

To all of them, and those that I failed to mention, this piece is sincerely dedicated, and

Above all, to the Almighty, who strengthens, provides guidance, and blesses me for having such incredible people around.

In conclusion, he is humbled and grateful for the support and guidance that he received from all these individuals. Their collective contributions have played an indispensable role in the successful completion of this field practice program.

ARIES JAN C. AVELLANEDA

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ABSTRACT

AVELLANEDA, ARIES JAN C., Bachelor of Science in Agricultural and Biosystems Engineering, Central Luzon State University, Science City of Muñoz, Nueva Ecija, July 2024, **COMPREHENSIVE SEMESTRAL REPORT OF THE FIELD PRACTICE AT THE PHILIPPINE-SINO CENTER FOR AGRICULTURAL TECHNOLOGY (PhilSCAT).**

Adviser: **MAY A. CABRAL, M.Sc.**

Field practice serves as a pivotal bridge between theoretical knowledge and practical application in various disciplines. Field practice encompasses a spectrum of experiential learning activities conducted outside traditional classroom settings. It offers a hands-on approach to reinforce theoretical concepts, fostering deeper understanding and skill acquisition. Whether in scientific research, social sciences, or professional training, field practice plays a crucial role in nurturing competent practitioners.

The field practice primarily focused on the performance evaluation of drone technology has advanced significantly over the last two decades in terms of flight stability, sensor capability, battery life, and price. Because of these improvements, drones are now more widely available and useful for a variety of industries, including agriculture. However, there aren't many reputable studies on RPAS because they are still relatively new and developing technology. Thus, this study was conducted to evaluate the performance of the RPAS' spreading system and application efficiency of the RPAS' spreading system. The RPAS spreading system was evaluated using application rate given its parameters. Performance parameters such as output rate, uniformity of distribution, and application rate were analyzed. The data were analyzed using ASABE methods of test. Each test had three replicates each at a single flight application of the

RPAS to assess the application rate of the rice seeding.

The field practice focused second with the performance evaluation of complete rice milling machine for well milled rice. Rice milling is an important part of the Philippine agriculture business considering the country is one of the world's major rice growers and consumers. Rice milling is the process of removing the outer husk, bran, and germ from paddy rice to create polished rice that is ready to eat. The average initial weight of the initial paddy input was 198.67 kilograms (5 cavans), while the average weight of the milled rice produced was 146.5 kg. The rice mill has a computed machine recovery of 73.73%. The proportion of head rice for each 200-gram sample was determined to be 84.72%, whereas the average percentage of broken rice is 16.21%. The study was done on a single rice variety, the IR 58025B (B-LINE).

Other activities were carried out throughout the time spent at the facility, the majority of which involved equipment operation and familiarization. Machine operation and familiarization are critical for agricultural engineers. Agricultural engineers design, develop, and optimize agricultural machinery and equipment. To execute these activities effectively, they must have hands-on experience and a thorough grasp of the machinery they deal with. Agricultural engineers who become expert machine operators may guarantee that equipment is run efficiently, increasing production and reducing downtime. Machine operation and familiarization are critical for agricultural engineers to improve their technical abilities, make educated equipment decisions, troubleshoot problems, assure safety, and communicate effectively with farmers.

LITERATURE CITED

- Ahmad, F., Khaliq, A., Qiu, B., Sultan, M., & Ma, J. (2021). *Advancements of Spraying Technology in Agriculture*. IntechOpen. doi: 10.5772/intechopen.98500
- Allagui, Asma & Bahrouni, Hassouna & Youssef, M'Sadak. (2018). *Deposition of Pesticide to the Soil and Plant Retention During Crop Spraying: The Art State*. Journal of Agricultural Science. 10. 104. 10.5539/jas.v10n12p104.
- Allen, M. J., & Lin, V. (2007). *Guidance and control of an autonomous soaring UAV* (No. II-2714).
- Chen, H., Lan, Y., Fritz, B. K., Hoffmann, W. C., & Liu, S. (2021). *Review of agricultural spraying technologies for plant protection using unmanned aerial vehicle (UAV)*. International Journal of Agricultural and Biological Engineering, 14(1), 38–49. <https://doi.org/10.25165/ijabc.v14i1.5714>
- Das, N., Maske, N.M., Khawas, V., Choudhary, S., & Dethe, E.R. (2015). *Agricultural Fertilizers and Pesticides Sprayers - A Review*. International Journal for Innovative Research in Science and Technology, 1, 44-47.
- Das, S. (2021). *Agriculture Drone: From Sci-Fi to Reality*. Al Ardh Al Khadra Agricultural. Soil-Conditioner Factory L.L.C. Retrieved from <https://www.aaaksc.com/agriculture-drone/>
- Dascalu, J. (2022, March 8). *Aerodynamics of multirotor drones*. GlobalSpec. <https://insights.globalspec.com/article/18303/aerodynamics-of-multirotor-drones>
- Davies, E. (2021). *Pesticide Drift: Causes and Adverse Health Effects*. Retrieved from <https://www.drugwatcher.org/effects-of-pesticide-drift/>
- Dekoulis, G. (Ed.). (2020). *Autonomous Vehicles*. IntechOpen. doi: 10.5772/intechopen.73376
- Department of Agriculture. (2002). *GUIDELINES ON THE SCALING UP THE USE OF MICROBIAL-BASED FERTILIZERS AS INTERVENTION TO REDUCE COST OF PRODUCTION IN RICE FARMING*. Retrieved from https://www.da.gov.ph/wp-content/uploads/2022/02/ao04_s2022.pdf
- DJI (n.d.). *Agras T30*. Retrieved from <https://www.dji.com/t30>
- Evaluate the Weather. (n.d.). *Pesticide Environmental Stewardship*. <https://pesticidestewardship.org/pesticide-drift/evaluate-the-weather/#:~:text=Wind%20speeds%20above%208%20mph,and%20may%20change%20direction%20rapidly.>
- Fishel, F.M., & Ferrell, J.A. (2010). *Managing Pesticide Drift*. EDIS. Retrieved from <https://edis.ifas.ufl.edu/publication/PI232>
- Gardisser, D.R. & Kuhlman, D.K. (2001). *Agricultural Aircraft Calibration and Setup for Spraying*. Cooperative Extension Service, University of Arkansas, U.S. Department of Agriculture, and County Governments Cooperating.
- Haman, D., & Yagar, T. (2022, July 26). *FIELD EVALUATION OF CONTAINER NURSERY IRRIGATION SYSTEMS: MEASURING UNIFORMITY OF WATER APPLICATION OF SPRINKLER SYSTEMS*. Ask IFAS - Powered by EDIS.

- <https://edis.ifas.ufl.edu/publication/AE194>
- International Fertilizer Development Centre (IFDC). *Fertilizer Deep Placement (FDP)*; IFDC: Muscle Shoals, AL, USA, 2013; Retrieved from <https://ifdc.org/fertilizer-deep-placement/>
- International Rice Research Institute. (n.d.). *Direct seeding - IRRI Rice Knowledge Bank*. Retrieved from <http://www.knowledgebank.irri.org/step-by-step-production/growth/planting/direct-seeding>
- Jamala, G.Y., Ari, B.M., Tsunda, B.M. and Waindu, C. (2013), "Assessment of agro-chemicals utilization by small-scale farmers in Gnyuk, Adamawa State, Nigeria," *Journal of Agriculture and Veterinary Science*, Vol. 6 No.2, pp. 51-59
- Kruger, G., Robert, K., Ogg, C., & Vieira, B. (2019, September). *Spray Drift of Pesticides*. extensionpublications.unl.edu. Retrieved from <https://extensionpublications.unl.edu/assets/pdf/g1773.pdf?fbclid=IwAR0FF0WJYGY2xpms4yYKp9bkSKhBHBRRZGgRGsIRgIko2QFyPOd99Xj931g>
- Laksham K. B. (2019). *Unmanned aerial vehicle (drones) in public health: A SWOT analysis*. *Journal of family medicine and primary care*, 8(2), 342–346. <https://doi.org/10.4103/jfmpe.jfmpe.413.18>
- Lu, J. L. (2010). *Analysis of Trends of the Types of Pesticide Used, Residues and Related Factors among Farmers in the Largest Vegetable Producing Area in the Philippines*. *Journal of rural medicine: JRM*, 5(2), 184–189. <https://doi.org/10.2185/jrm.5.184>
- Martos, V., Ahmad, A., Cartujo, P., Ordoñez, J. (2021). *Ensuring Agricultural Sustainability through Remote Sensing in the Era of Agriculture 5.0*. *Appl. Sci.* **2021**, 11, 5911. <https://doi.org/10.3390/app11135911>
- Meola, A. (2021). *Precision agriculture in 2021: The future of farming is using drones and sensors for efficient mapping and spraying*. Retrieved from <https://www.businessinsider.com/agricultural-drones-precision-mapping-spraying>
- Murison, M. (2020). *Fixed-Wing vs Multirotor: Which Drone Should You Choose for Aerial Surveying? DJI Enterprise*. Retrieved from <https://enterprise-insights.dji.com/blog/fixed-wing-vs-multirotor-drone-surveying>
- Naji, I. (2019). "The Drones' Impact on Precision Agriculture." *ETD Collection for University of Texas, El Paso*. AAI27668778. <https://scholarworks.utep.edu/dissertations/AAI27668778>
- Nordin, M. N., Jusoh, M. S. M., Bakar, B. H. A., Ahmad, M. T., Mail, M. F., Vun, C. T., Chuang, T. C., Bastri, M. S. H., & Zolkafli, A. K. (2021). *Study on Water Distribution of Spraying Drone by different Speed and Altitude*. *Advances in Agricultural and Food Research Journal*. <https://doi.org/10.36877/aafirj.a0000215>
- Pajares, G. (2015). Overview and current status of remote sensing applications based on unmanned aerial Vehicles (UAVs). *Photogrammetric Engineering and Remote Sensing*, 81(4), 281–330. <https://doi.org/10.14358/pers.81.4.281>
- Pathak P., Damle M., Pal P.R., Yadav V. (2019). *Humanitarian impact of drones in healthcare and disaster management*. *Int. J. Recent Technol. Eng.* 2019;7(5):201–205.

- Rees, C. (2015, March 31). *Arcturus JUMPTM15 Fixed Wing VTOL UAV | Unmanned Systems Technology*. Unmanned Systems Technology. <https://www.unmannedsystemstechnology.com/video/arcturus-jump15-fixed-wing-vtol-uav/>
- S386.2; ASABE Standards. Calibration and Distribution Pattern Testing of Agricultural Aerial Application Equipment. ASABE: St. Joseph, MI, USA, 2018.
- Simula, A. (2021). *Establishing drone technology to agriculture as a service provider*. JAMK University of Applied Sciences. Retrieved from https://www.theseus.fi/bitstream/handle/10024/504391/Opinn%C3%A4vtety%C3%B6_Antti_Simula.pdf?sequence=2
- Singh, I. (2021). *What's the difference between drones, UAS, UAV, and RPAS?* Retrieved from <https://dronedj.com/2021/12/07/drone-uav-uas-difference-explained/>
- Syam, H., Jamaluddin, & Rahman, K. (n.d.). *Design and test of unmanned aerial vehicle (UAV) spraying capacity in quadcopter based plant spraying system*. Universitas Negeri Makassar. ISBN: 978-623-7496-62-5
- Tomas, M. (2022, January 27). *40kg of high-quality rice seeds enough for 1-ha field*. Philippine Rice Research Institute. <https://www.philrice.gov.ph/40kg-of-high-quality-rice-seeds-enough-for-1-ha-field/>
- Tudi, M., Daniel Ruan, H., Wang, L., Iyu, J., Sadler, R., Connell, D., Chu, C., & Phung, D. T. (2021). Agriculture Development, Pesticide Application and Its Impact on the Environment. *International journal of environmental research and public health*, 18(3), 1112. <https://doi.org/10.3390/ijerph18031112>
- UAV Systems. *What Is A Fixed Wing Drone? | Advantages And Uses Of Fixed Wing Drones*. UAV Systems International. Retrieved from <https://uavsystemsinternational.com/blogs/drone-guides/what-is-a-fixed-wing-drone-advantages-and-uses-of-fixed-wing-drones>
- University of Massachusetts Amherst. (2016, October 26). *Sprayers and spray application techniques*. Center for Agriculture, Food, and the Environment. <https://ag.umass.edu/greenhouse-floriculture/fact-sheets/sprayers-spray-application-techniques>
- Yang, S., Yang, X., & Mo, J. (2017). The application of unmanned aircraft systems to plant protection in China. *Precision Agriculture*, 19(2), 278–292. <https://doi.org/10.1007/s11119-017-9516-7>
- Yinka-Banjo, C., & Ajayi, O. (2020). Sky-Farmers: Applications of Unmanned Aerial Vehicles (UAV) in agriculture. In *IntechOpen eBooks*. <https://doi.org/10.5772/intechopen.89488>
- Zhang Y L, Lian Q, Zhang W. (2017). Design and test of a six-rotor unmanned aerial vehicle (UAV) electrostatic spraying system for crop protection. *Int J Agric & Biol Eng*, 2017; 10(6): 68–76.