PERFORMANCE EVALUATION OF DRIP IRRIGATION SYSTEM IN UPLAND AREA OF PALAYAN CITY, NUEVA ECIJA USING RED RICE, BLACK RICE, AND HYBRID RICE (*Oryza sativa*)

DENIELLE T. CAMANIA
DIANE C. CRUZ

An undergraduate Thesis Submitted to the Faculty of the Department of Agriculture and Biosystems Engineering, College of Engineering, Central Luzon State University, Science City of Munoz, Nueva Ecija, Philippines
In Partial Fulfillment of the Requirements
for the degree of

BACHELOR OF SCIENCE IN AGRICULTURAL AND BIOSYSTEMS ENGINEERING
(AB Land and Water Resource Engineering)

JUNE 2023

TABLE OF CONTENTS

LIST OF TABLE

LIST OF FIGURES

LIST OF APPENDIX TABLES

LIST OF APPENDIX FIGURES

ABSTRACT

CAMANIA, DENIELLE T. and CRUZ, DIANE C., Department of Agricultural and Biosystems Engineering, College of Engineering, Central Luzon State University, Science City of Muñoz, Nueva Ecija, Philippines, **June 2023, PERFORMANCE EVALUATION OF DRIP IRRIGATION SYSTEM IN UPLAND AREA OF PALAYAN CITY, NUEVA ECIJA USING RED RICE, BLACK RICE, AND HYBRID RICE (*Oryza sativa*).**

Adviser: WENDY C. MATEO, Ph.D.

The semi-aquatic plant known as *Oryza sativa*, commonly referred to as rice, relies on approximately 24-30% of the Earth's freshwater supply. However, the increasing global population and the growing scarcity of water resources pose significant challenges to rice production in various regions. In present day, various water saving technologies were made. One of the most efficient practices is drip irrigation system. The objective of this research was to develop a layout for gravity-fed drip irrigation specifically designed for upland areas cultivating hybrid rice, red rice, and black rice. The study also assesse various performance parameters of the drip irrigation system, including the uniformity coefficient (CU%), application efficiency (Ea%), distribution uniformity (DU%), emission uniformity (EU%), and average discharge. Additionally, it evaluates important plant growth parameters such as plant height, number of leaves, and crop yield. The findings demonstrate the successful implementation of the drip irrigation system in hybrid rice, red rice, and black rice. Overall, the application efficiency (Ea%) was determined to be 70.05%. The measured uniformity coefficient (CU%) was found to be 58%, while the distribution uniformity (DU%) achieved a value of 74.32%, calculated based on the field test emission efficiency. The average recorded discharge was 15.47 l/h. In summary, these results highlight the effective

performance of the constructed and installed drip irrigation system. In addition, statistically, a 5% significance level indicated no significant difference in plant height, leaf count, and yield among the three treatments. However, Red rice showed the tallest plants. Longping 2096 had the highest leaf count, while Black rice achieved the highest yield, followed by Red rice. Longping 2096 had the lowest yield. Based on these findings, it can be concluded that Black rice is the most suitable variety for upland farming when utilizing gravity-fed drip irrigation.

LITERATURE CITED

Akinyi, A. G. (2010). Design of a Drip rrigation System (Case Study of Namekhele village). *University of Nairobi*.

Andales, A. A., Chavez, J. L., & Bauder, T. A. (2015). Irrigation Scheduling: The Water Balance Approach – 4.707. *Colorado State University Extension*.

Antonio, A. C. (2014). *Thoughts to Promote Positive Action...: Biophysical Characteristics of the Uplands*. http://antonantonio.blogspot.com/2015/01/biophysical-characteristics-of-uplands.html

Assouline, S., Cohen, S., Meerbach, D., Harodi, T., & Rosner, M. (2002). Microdrip Irrigation of Field Crops. *Soil Science Society of America Journal*, *66*(1), 228–235. https://doi.org/10.2136/sssaj2002.2280

Atlin, G. N., Lafitte, H. R., Tao, D., Laza, M., Amante, M., & Courtois, B. (2006). Developing rice cultivars for high-fertility upland systems in the Asian tropics. *Field Crops Research*, *97*(1), 43–52.

Awanis, S., Purwanto, E., & Rahayu, M. (2022). The potential of Central Java local black rice and red rice as drought tolerant cultivars. *3rd International Conference on Agribusiness and Rural Development (IConARD 2022)*, *361*, 7.

Bartok Jr., J. W. (2017). Improve irrigation application uniformity. *Greenhouse Management*.

Belder, P. (2005). *Water saving in lowland rice production: An experimental and modelling study*.

Carating, R. B., Galanta, R. G., & Bacatio, C. D. (2014). *The Soils of the Uplands*. 107–148. https://doi.org/10.1007/978-94-017-8682-9_3

Dasgupta, P., Das, B. S., & Sen, S. K. (2015). Soil water potential and recoverable water stress in drought tolerant and susceptible rice varieties. *Agricultural Water Management*.

Datta, A., Ullah, H., & Ferdous, Z. (2017). Water management in rice. *Rice Production Worldwide*, 255–277. https://doi.org/10.1007/978-3-319-47516-5_11/COVER

Department of Agriculture, P. R. R. I. (2015). *PhilRice develops cheaper irrigation for small-scale farms*

Department of Primary Industries and Regional Development. (2016). *Measuring delivery of drip irrigation systems | Agriculture and Food*.

FAO. (2010). *RICE PRODUCTION IN THE ASIA-PACIFIC REGION: ISSUES AND PERSPECTIVES - M.K. Papademetriou**.

Garcia, P. P., & Bañoc, D. M. (2020). Gowth and yield performance of upland rice (Oryza sativa l.) cultivars under rainfed lowland conditions. *SVU-International Journal of Agricultural Science*.

Gleick, P. H. (1993). Water and Conflict: Fresh Water Resources and International Security. *International Security*, *18*(1), 79. https://doi.org/10.2307/2539033

He, H., Ma, F., Yang, R., Chen, L., Jia, B., Cui, J., Fan, H., Wang, X., & Li, L. (2013a). *Rice Performance and Water Use Efficiency under Plastic Mulching with Drip Irrigation*.

He, H., Ma, F., Yang, R., Chen, L., Jia, B., Cui, J., Fan, H., Wang, X., & Li, L. (2013b). *Rice Performance and Water Use Efficiency under Plastic Mulching with Drip Irrigation*.

International Conference on Dryland Farming. (2002). *Challenges in Dryland Agriculture*.

International Rice Research Institute. (2007). *Rice Breeding*. International Rice Research Institute.

Jamrey, P., & Nigam, G. (2018). Performance evaluation of drip irrigation systems. *The Pharma Innovation International Journal*.

Kaushal, A., Patole, R., & Singh, K. G. (2012). *DRIP IRRIGATION IN SUGARCANE: A REVIEW*.

Keck, A. (2021). Evapotranspiration: Watching Over Water Use. *National Aeronautics and Space Administration*.

Kumari, R., & Kaushal, A. (2014). Drip Fertigation in Sweet Pepper: A Review. In *Journal of Engineering Research and Applications www.ijera.com* (Vol. 4, Issue 8). www.ijera.com

Landicho. (2003). *Hybrid Rice Cultivation in the Philippines: Early Farm-Level Experiences | Request PDF*.

Landicho, L. D., Cabahug, R. E. D., Baliton, R. S., & Gonzales, A. B. (2022). Rainwater harvesting for enhancing upland agriculture: Lessons and experiences in selected upland farming communities in Albay Province, Philippines. *Philippines. APN Science Bulletin*, *12*(1), 18–28. https://doi.org/10.30852/sb.2022.1757

Levidow, L., Zaccaria, D., Maia, R., Vivas, E., Todorovic, M., & Scardigno, A. (2014). Improving water-efficient irrigation: Prospects and difficulties of innovative practices. *Agricultural Water Management*, *146*, 84–94. https://doi.org/10.1016/j.agwat.2014.07.012

Maisiri, N., Senzanje, A., Rockstrom, J., & Twomlow, S. J. (2005). On farm evaluation of the effect of low-cost drip irrigation on water and crop productivity compared to conventional surface irrigation system. *Physics and Chemistry of the Earth*, *30*(11-16 SPEC. ISS.), 783–791. https://doi.org/10.1016/J.PCE.2005.08.021

Maramara, R. (2020). *Local hybrid rice varieties promoted | PRRI*. Department of Agriculture, Philippine Rice Research Institute. https://www.philrice.gov.ph/local-hybrid-rice-varieties-promoted/

Mariano Marcos State University. (2022). *President's Farm is verdant green with the newly released high-yielding rice varieties*.

Medley, J., & Wilson, L. (2008). *The Use of Sub-surface Drip Irrigation for rice*. Proceedings of 32nd Rice Technical Working Group Meeting.

OECD-FAO. (2021). *Crop Production*. OECD-FAO Agricultural Outlook (Edition 2021).

Ottis, B. V., & Talbert, R. E. (2005). Rice Yield Components as Affected by Cultivar and Seeding Rate. *Agronomy Journal*, *97*(6), 1622–1625. https://doi.org/10.2134/AGRONJ2005.0123

Padmanabhan, S. (2019). *DRIP IRRIGATION TECHNOLOGY FOR RICE CULTIVATION FOR ENHANCING RICE PRODUCTIVITY AND REDUCING WATER CONSUMPTION*.

Pandey, A. C. (2017). *Design of Drip Irrigation Method*.

Parthasarathi, T., Vanitha, K., Mohandass, S., & Vered, E. (2018). Evaluation of Drip Irrigation System for Water Productivity and Yield of Rice. *Agronomy Journal*, *110*(6), 2378–2389. https://doi.org/10.2134/AGRONJ2018.01.0002

Prince, R. (2016). Evaporation-based irrigation scheduling. *Agriculture and Food*.

Priya, K. C., Bhagat, Er. I., & Kumar, N. (2018). Emission uniformity evaluation of installed drip irrigation system. *International Journal of Chemical Studies*.

Purwanto, E., Hidayati, W., & Nandariyah. (2018). The yield and quality of black rice varieties in different altitude. *IOP Conference Series: Earth and Environmental Science*.

Ramesh, T., Rathika, S., Subramanian, E., & Ravi, V. (2020). Effect of Drip Fertigation on the Productivity of Hybrid Rice. *International Journal of Agriculture, Environment and Biotechnology*.

Rao, K. V. R., Gangwar, S., Keshri, R., Chourasia, L., Bajpai, A., & Soni, K. (2017). Effects of drip irrigation system for enhancing rice (Oryza sativa L.) yield under system of rice intensification management. *Applied Ecology and Environmental Research*, *15*(4), 487–495. https://doi.org/10.15666/aeer/1504_487495

Raphael, D. O., Amodu, M., Okunade, D. A., Elemile, O., & Gbadamosi, A. A. (2018). Field evaluation of gravity-fed surface drip irrigation systems in a sloped greenhouse. *International Journal of Civil Engineering and Technology*.

Richter, B. D., Davis, M. M., Apse, C., & Konrad, C. (2012). Methodology for Water quantification in Drip Irrigation Practices. *River Research and Applications*.

Samoy-Pascual, K., Lampayan, R. M., Donayre, D. K., Remocal, A., Fumera, Ja., & Orge, R. (2022). *techno-guide-drip-irrigated-aerobic-rice*.

Sandoval-Solis, Orang, S., Snyder, M., Williams, S., & Rodriguez. (n.d.). *Spatial and Temporal Analysis of Application Efficiencies in Irrigation Systems for the State of California*.

Sarvestani, Z. T., Pirdashti, H., Sanavy, S. A. M. M., & Balouchi, H. (2008). Study of water stress effects in different growth stages on yield and yield components of different rice (Oryza sativa L.) cultivars. *Pak J Biol Sci*.

Singh, A. (2012). *An Introduction to Drip Irrigation Systems*.

Slow Food Foundation for Biodiversity. (2023). *Kalinga Ulikan Red Rice*. Slow Food.

Stauffer, B. (2020). *Drip Irrigation | SSWM - Find tools for sustainable sanitation and water management!* https://sswm.info/sswm-solutions-bop-markets/affordable-wash-services-and-products/affordable-technologies-and/drip-irrigation

Tiwari, K. N., & Raghuwanshi, N. S. (2014). Irrigation Efficiency. *Irrigation Engineering*.

University of California and W-2128. (2023). *Drip emitter evaluation example - Maintenance of Microirrigation Systems*.

Wang, H., Li, J., Cheng, M., Zhang, F., Wang, X., Fan, J., Wu, L., Fang, D., Zou, H., & Xiang, Y. (2019). Optimal drip fertigation management improves yield, quality, water and nitrogen use efficiency of greenhouse cucumber. *Scientia Horticulturae*, *243*, 357–366. https://doi.org/10.1016/J.SCIENTA.2018.08.050

Xu, Q., Ma, X., Lv, T., Bai, M., Wang, Z., & Niu, J. (2020). Effects of Water Stress on Fluorescence Parameters and Photosynthetic Characteristics of Drip Irrigation in Rice. *Water*.

Yuniarti, A., Machfud, Y., Damayani, M., & Solihin, E. (2019). *The application of various types of organic fertilizer and N, P, K combination on soil fertility, growth and yield of black rice*.

Zazueta, F. S. (2009). Understanding the Concepts of Uniformity and Efficiency in Irrigation. *University of Florida IFAS Extension*.

Zellman, P. (2016). *Drip Irrigation System Evaluations: How to Measure & Use Distribution Uniformity Tests*.