INFOGAIN PUBLICATION

International Journal of Advanced Engineering, Management and Science (IJAEMS)
Peer-Reviewed Journal
ISSN: 2454-1311 | Vol-9, Issue-12; Dec, 2023
Journal Home Page: https://ijaems.com/
DOI: https://dx.doi.org/10.22161/ijaems.912.11

Management and Operation Practices of Philmech's Fluidized Bed Dryer: Examining the Challenges, Efficiency, and Impact on Beneficiaries

Jerelyn P. Sarmiento[1], Angela Lea DR. Ramirez[2], Angeli Mae DR. Miguel[3], Arianne DC. Tonido[4], Quennie Q. Sayson[5], Jocelyn B. Cruz, PhD[6]

[1]Administrative Officer II & Administrative Officer III[2], Department of Agriculture, Philippine Center for Postharvest Development and Mechanization
[3]Administrative Assistant II, Central Luzon State University
[4]Legal Assistant, GM Bank of Luzon, Inc.
[5]Administrative Assistant II, Department of Education
[6]Graduate School Dean, Nueva Ecija University of Science and Technology

Received: 03 Nov 2023; Received in revised form: 06 Dec 2023; Accepted: 18 Dec 2023; Available online: 28 Dec 2023

Abstract**—** *This descriptive research explores the management and operation practices of PHilMech's Fluidized Bed Dryer as to challenges, efficiency and impact on its beneficiaries. The findings of the study reveal that the respondents adhere to prescribed guidelines for the administration and operation of the PHilMech Fluidized Bed Dryer, employing explicit, written, easily understood, and enforceable operational policies and procedures. Most of them have assimilated the knowledge acquired through several training programs, as new competencies need to be developed among farmers, particularly those who are introducing machinery. This will enable them to optimize the economic benefits derived from their equipment. There are ongoing challenges in the operation and management of the system that must be resolved to prevent future issues and ensure the system's continued functionality. Furthermore, it is imperative to implement mechanized drying technologies to mitigate postharvest losses and alleviate the labor-intensive and monotonous nature of the drying process. Extensive research has demonstrated the effectiveness and beneficial outcomes of utilizing the fluidized bed drying system, including a reduced drying period for a harvested rice paddy, decreased operating and labor expenses, and a diminished reliance on the laborious and labor-intensive sun drying method.*

Keywords**— Challenges, Fluidized Bed Dryer, Impact on Beneficiaries, Management, Operational Practices**

I. INTRODUCTION

Rice is a staple food for about eighty (80) percent of Filipinos and is, therefore, a major item in the consumption basket of consumers (Bordey, 2010). It is the single most important agricultural crop in the Philippines and a major source of income for millions of Filipino farmers. In connection with this, several processes were involved in rice production from field preparation and planting until harvest, milling and storage. On the production side, the growth and development of rice production have become completely dependent on yield improvements.

Rice quality is the major factor affecting its market value. Immediately following harvest, rice quality is typically at its peak. A primary measure of rice quality is greatly influenced by drying. The final quality of rice, that is ready to market, is sensitive to all post-harvest processes, such as drying, handling, storage, and milling. Accordingly, rice drying and storage have the potential to increase harvest efficiency and provide more control over grain quality, all of which contribute to the overall quality of harvest. In the Philippines, sun drying is a traditional drying method for reducing the moisture content of paddy by spreading the

grains under the sun. According to Rice Knowledge Bank, it is the most common drying method in Asia because of its low cost compared to mechanical drying. It requires little investment and is environmentally friendly since it uses the sun as the heat source. However, sun drying tends to be labor-intensive and has limited capacity. Temperature control is also difficult in this method and grains can easily be overheated causing cracked grains which leads to low milling quality. It is also not possible to sun dry at night or during rain. Drying of harvested rice paddy remains a major problem of the Philippine rice production industry especially during the wet season when sun drying is not always possible. Wet rice paddy deteriorates rapidly, if not immediately dried, may result in loss in quality, low price and sometimes market rejection.

Rice Knowledge Bank states that sun drying is the most common drying method in Asia because of its low cost compared to mechanical drying. It requires little investment and is environmentally friendly since it uses the sun as the heat source and therefore produces no CO_2. However, sun drying tends to be labor-intensive and has limited capacity. Temperature control is also difficult in this method and grains can easily be overheated causing cracked grains which leads to low milling quality. It is also not possible to sun dry at night or during rain. With this regard, the Philippine Center for Postharvest and Development Mechanization (PhilMech) started developing a fluidized bed drying system in 2012 that aims to boost the production yield to provide a better grain drying system for rice farmers. The ideal moisture content for palay is 14 percent but the prototype tested by PHilMech can dry 20 to 24 tons of palay in 10 to 12 hours. The machine uses heat generated by a PHilMech-designed biomass furnace or a diesel burner. It also has electronic controls that lessen the need for laborers to operate. PHilMech is optimistic that many farmers' cooperatives and associations will gain interest in using the Fluidized Bed Dryer once it is ready for commercialization Based on laboratory drying experiments and pilot-scale model results, an initial full-scale prototype was developed and tested, and results showed good potential for rapid drying of high moisture paddy. The prototype needs further improvement to operate reliably and viably as a first-stage drying component of a two-stage drying strategy recommended for the adoption of rice farmer cooperatives and associations (FCAs) in Nueva Ecija. Two cooperatives are involved in the testing and evaluation process: the Nagkakaisang Magsasaka Agricultural Primary Multipurpose Cooperative in Tabaco, Talavera and the Bagong Buhay ng Mabini Primary Multipurpose Cooperative in Sto. Domingo, Nueva Ecija. The current prototype model has a bigger capacity and once commercialized, will be a great benefit to rice farmers as much of the drying of their harvests, as the Director IV of PhilMech stated in one of his interviews.

This study specifically intends to:

1. Identify the Management and Operational Practices of PHilMech Fluidized Bed Dryer Beneficiaries;
2. Describe the Challenges Encountered in Batch Recirculating Dryers and Fluidized Bed on First Stage Drying; and
3. Describe the Efficiency and Impact of the Fluidized Bed Drying System to its Beneficiaries.

II. METHODOLOGY

This study utilized a descriptive research design to describe the preparedness (Subia, Mangiduyos & Turgano, 2020) on the management and operation practices of PhilMech Fluidized Bed Dryer beneficiaries particularly through a questionnaire to gather the necessary data needed. A review and secondary data gathering were also conducted. Basic descriptive statistics such as frequency count and percentage were used. The researchers gathered the necessary data and information from three of the cooperative members in each of the selected beneficiaries, namely the Nagkakaisang Magsasaka Agricultural Primary Multipurpose Cooperative in Tabaco, Talavera and the Bagong Buhay ng Mabini Primary Multipurpose Cooperative in Sto. Domingo, Nueva Ecija they were the direct beneficiaries based on the set criteria of PHilMech and were selected through a combination of desk research, written communication, and phone interviews and actual visits conducted by the agency. This created a bridge for the researcher to gain a broader sense of understanding and better insight regarding the matter on-hand. Analysis of the result determined the possible recommendations to weed out important impressions and how to address the challenges and opportunities and the feasibility of using a multistage fluidized bed system for complete drying of high moisture paddy and identify ways to accelerate the promotion and adoption of fluidized bed dryers through technology demonstration and training of potential adopters.

III. RESULTS AND DISCUSSION

Table 1. Management and Operation Practices of PHilMech Fluidized Bed Dryer Beneficiaries

Statement	Frequency (f)	Percentage (%)
1. Our management team has received training to operate and oversee the fluidized bed drying system	6	100
2. Our operating policies and procedures are clear, written, comprehensible and enforceable.	6	100
3. We inspect the bed drying system before and after use	4	67
4. We are regularly and actively engaged in government workshops, seminars, trainings, and other activities.	5	83
5. We avail different programs and support from external institutions (LGU, PHilMech, CDA, DA-RFO and other government agencies)	5	83

Table 1 shows the results from the responses of the respondents regarding the management and operation practices of the PHilMech Fluidized Bed Dryer. 100% of the respondents have received training to operate and oversee the fluidized bed drying system; 100% have clear, written, comprehensible and enforceable operating policies and procedures; 67% inspect the bed drying system before and after use; 83% regularly and actively engaged in government workshops, seminars, training, and other activities; and 83% avail different programs and support from external institutions (LGU, PHilMech, CDA, DA-RFO and other government agencies).

The results demonstrate that the majority of respondents follow recommended practices when it comes to the management and operation of the PHilMech Fluidized Bed Dryer. The majority of them have incorporated the knowledge they gained from participating in various trainings conducted by external institutions. A study conducted by Girja Sharan, a professor at the Centre for Management in Agriculture at the Indian Institute of Management Ahmedabad, stated that effective utilization of farm machinery requires more than the transfer of information. New skills have to be built among farmers, especially those introducing machinery. Moreover, skill training will help the beneficiaries to decrease the expense of maintenance and use. It will also increase farmer acceptance and allow them to get the most out of their equipment economically.

Table 2. Challenges and problems encountered in batch recirculating dryers and fluidized beds on first-stage drying

Statement	Frequency (f)	Percentage (%)
1. The management team lacks training (ex. leadership, operating, troubleshooting, etc.)	2	33
2. Low acceptability of the system	2	33
3. Frequent breakdown of the machine (eg: frequent clogging, malfunction, etc.)	3	50
4. The maintenance cost of the system is high (eg: for repairs, adjustments, etc.)	2	33

Table 2 shows the results from the responses of the respondents regarding the challenges and problems encountered in batch recirculating dryers and fluidized beds on first stage drying. 33% of the respondents stated that the management team lacks training (ex. leadership, operating, troubleshooting, etc.); 22% have low acceptability of the system; 50% of the respondents experienced the frequent breakdown of machines (eg: frequent clogging, malfunction, etc.); and 33% experienced high maintenance cost of the system (eg: for repairs, adjustments, etc.).

Table 3. Efficiency and Impact of the Fluidized Bed Drying System to its Beneficiaries

Statement	Frequency (f)	Percentage (%)
1. Shortened drying period/drying cycle of grains/rice paddy.	6	100
2. Lower operating and labor costs.	6	100
3. Improved grain quality and higher volume of moisture grain.	5	83
4. Reduction of drudgery and labor-intensive activity associated with sun drying methods.	6	100

Table 3 shows the efficiency and Impact of the Fluidized Bed Drying System versus the traditional sun drying method. 100% of the respondents experienced shortened drying period/drying cycle of grains/rice paddy; 100% said that using the fluidized bed drying method has lower operating and labor cost; 83% has improved grain quality and higher volume of moisture grain; and 100% experienced reduction of drudgery and labor-intensive activity associated with sun drying method.

The data shows some of the identified impacts of adopting the two-stage fluidized bed drying system. The Philippine rice industry continues to face significant drying issues, particularly during the wet season when sun drying is not always possible. If not immediately dried, wet rice paddy quickly degrades, leading to a loss in quality, a drop in price, and occasionally market rejection. Depending on the moisture level of the harvest, drying takes 1-2 days in a sunny environment. When it rains, drying takes longer, therefore workers must remove the grains from the pavement as it dries and bring them back the next day for the next round of drying. Therefore, there is a need to provide mechanized drying technologies to minimize postharvest losses and reduce the labor-intensive drudgery of drying (Pontawe, 2013).

IV. CONCLUSION AND RECOMMENDATIONS

The following conclusions were made based on the results and discussions:

1. The majority of respondents follow recommended practices when it comes to the management and operation of the PHilMech Fluidized Bed Dryer using their clear, written, comprehensible and enforceable operating policies and procedures. The majority of them have incorporated the knowledge they gained from participating in various training as new skills have to be built among farmers, especially those introducing machinery as this will allow them to get the most out of their equipment economically.
2. There are still minimal issues and dilemmas encountered in the operation and management of the system that need to be addressed to avoid problems in the long run and to be able to continue the operation of the said system.
3. There is a need to provide mechanized drying technologies to minimize postharvest losses and reduce the labor-intensive and drudgery of drying as significant factors were determined that show the efficiency and positive impact of using the fluidized bed drying system such as the shortened drying period or drying cycle of harvested rice paddy, lower operating and labor cost, and reduction of drudgery and labor-intensive activity associated with sun drying method.

Based on the findings and conclusions, the following were recommended:

1. PHILMECH, as the implementer, should continuously conduct technology awareness and promotion simultaneously during the operationalization stage such as techno-forum, field day, techno demo and other activities in collaboration with LGUs, DA-RFOs and other agencies interested in the technology as well as the local manufacturer. Awareness and promotion will be carried out to raise public knowledge of the existence of this technology. In addition to raising awareness, this will demonstrate and prepare the beneficiaries for the reality (Subia, 2020) of how to use the technology beneficially.
2. PHILMECH, as the implementer, should establish linkages and develop exit plans that should be crafted in consultation and coordination with the project cooperator to make sure that the technology adoption is sustainable. This includes regular monitoring and visits of PHILMECH to provide general and specific assistance and guidance to sustain its use as an indispensable facility.
3. The government should continue to provide funds to be allocated to postharvest technologies as through better technologies, facilities, and techniques, quality can be preserved, lower production and labor cost can be

achieved and farmers can sell their commodities at higher prices.

REFERENCES

[1] Chupungco A., et al. (2008). *Two-stage grain drying in the Philippines*. ACIAR Impact Assessment Series Report No. 59, 50 pp. https://www.aciar.gov.au/sites/default/files/legacy/node/10108/IAS59.pdf

[2] Das, A (2018, April 17). *The Manual Drying Process of Rice Grain*. Unframe. https://unframe.com/the-manual-drying-process-of-rice-grain/

[3] Development and Mechanization. Science City of Muñoz, Nueva Ecija. 26 pp. https://www.philmech.gov.ph/assets/publication/Technical%20Bulletin/Technical%20Bulletin%20No.%2011.pdf

[4] Gomez, E. (2022, February 22). *Fluidized Dryer Test Completion eyed this year*. The Manila Times. https://www.manilatimes.net/2022/02/24/business/agribusiness/fluidized-dryer-test-completion-eyed-this-year/1833997

[5] Koirala, K., Mishra, A., Mohanty, S. (2014, February). *Determinants of Rice Productivity and Technical Efficiency in the Philippines*. https://www.researchgate.net/publication/266674411_Determinants_of_Rice_Productivity_and_Technical_Efficiency_in_the_Philippines

[6] Lagare, J. (2022, February 22*). Philmech Readies Improved Palay Drying System Philippine Inquirer*. The Inquirer. https://business.inquirer.net/341428/philmech-readies-improved-palay-drying-system

[7] Lagare, J. (2022, February 21). *Fluidized Bed Drying System. (n.d.) Fluidized Bed Drying*. The Inquirer. https://business.inquirer.net/341428/philmech-readies-improved-palay-drying-system

[8] *Mechanical Drying of Palay for Quality Milled Rice*. (2008). University Library, University of the Philippines (UP Los Banos. https://agris.fao.org/agris-search/search.do?recordID=PH2009001196

[9] Nguyen-Van-Hung., et al. (2018). *Best Practices for Paddy Drying: A Case Study in Vietnam, Cambodia, Myanmar and Vietnam.* https://doi.org/10.1080/1343943X.2018.1543547

[10] On-Farm Rice Drying and Storage. (2009). University of Arkansas, Division of Agriculture. https://www.uaex.uada.edu/

[11] *PHilMech set to commercialize a Fluidized Bed Dryer*. (2018, September 25). https://www.philmech.gov.ph/?page=story_full_view&action=story_fullview&recordID=NEPHI2018090002&recordCategory=News

[12] PHilMech Technical Bulletin Vol. 6 No. 1. Philippine Center for Postharvest

[13] Pontawe, R.J. et al (2016). *Pilot-Scale Fluidized Bed Drying System for Complete Drying of Paddy.*

[14] Romero, M. (2022, February 22). *Post-Harvest Equipment to Raise Farm Yield*.

[15] https://www.philmech.gov.ph/?page=story_full_view&action=story_fullview&recordID=202222213630PMc160db&recordCategory=News

[16] Sharan, G. (1988) *Training Farmers for Mechanization*. https://journals.sagepub.com/doi/pdf/10.1177/0256090919880204#:~:text=It%20will%20create%20equipment%20demand,is%20a%20skill%20building%20task.

[17] Subia, G. S., Mangiduyos, G. P., & Turgano, J. B. D. (2020). Emergency Preparedness of Novo Ecijanos. Open Journal of Social Sciences, 8, 17-23. https://doi.org/10.4236/jss.2020.83003

[18] *Subia, G. S. (2020). Fortuitous: A proposed activity-based book in mathematics of chance. International Journal of Scientific and Technology Research, 9(3), 450–453.*

[19] *Sun Drying in the Philippines*. (2012). Rice Knowledge Bank. http://www.knowledgebank.irri.org/step-by-step-production/postharvest/drying/traditional-drying-systems/sun-drying

[20] Tesla News. (2016, March 10). *PHILMECH developed a fluidized bed drying system*. [Video]. YouTube. https://www.youtube.com/watch?v=x9yM-7XNazk