THE UNITED REPUBLIC OF TANZANIA

MINISTRY OF EDUCATION, SCIENCE AND TECHNOLOGY

THE NELSON MANDELA AFRICAN INSTITUTION OF SCIENCE AND TECHNOLOGY (NM-AIST)

OFFICE OF THE DEAN
SCHOOL OF MATERIALS ENERGY WATER AND ENVIRONMENTAL SCIENCE (MEWES)

Our Ref: BD. 335/902/01/54 **Date:** 10th September, 2024

TO: **The Public**

REF: **ANNOUNCEMENT OF VIVA VOCE EXAMINATION OF A PhD CANDIDATE, EVORDIUS LAURENT RULAZI (P026/T20)**

Please, refer to the heading above,

The **School of Materials Energy Water and Environmental Science (MEWES)** of the **Nelson Mandela African Institution of Science and Technology (NM-AIST)**, wishes to announce the VIVA-VOCE Examination of **EVORDIUS LAURENT RULAZI (P026/T20),** a PhD candidate in **SUSTAINABLE ENERGY SCIENCE AND ENGINEERING.**

The **VIVA VOCE** examination is scheduled on: **Tuesday, 24th September, 2024 from 10:00 am to 1:00 pm**

Research Title: **"Development and Performance Evaluation of a Solar Dryer Integrated with Thermal Energy Storage Materials for Drying Agricultural Products.**

ABSTRACT

Passive solar dryers play a crucial role in reducing post-harvest losses in fruits and vegetables, especially in regions like Sub-Saharan Africa. Most simple passive solar dryers are being developed in developing countries; however, the intermittent nature of solar energy poses a significant challenge leading to low performance and making them useless in the absence of sunlight. In addition, techno-economic analysis (TEA) and life cycle assessment (LCA) have been neglected in most of the studies on solar dryers. In this study, a novel solar dryer incorporating soapstone as a thermal energy storage (TES) system to prolong the drying time

was designed, constructed, and evaluated for its performance in terms of TEA and LCA. The comparative experiments for the developed dryer were conducted in two modes; dryer with TES materials and dryer without TES materials and the results were compared with open-sun drying (OSD) by drying 50 kg of fresh pineapple and carrot at different times. The drying times for the dryer with TES, without TES, and OSD were 12, 23, and 50 hours, respectively. Moreover, the dryer integrated with TES materials could supply energy for around 3–4 hours after sunset. The thermal, collector, and storage efficiencies of the dryer were calculated and found to be 45%, 43%, and 74.5%, respectively. Proximate analysis indicated that the dryer integrated with TES materials was more effective in retaining nutrients in the dried products compared to the dryer without TES materials and OSD. The economic analysis showed that the annual savings for the dryer's 20 years of operation are $ 9,814.5 for pineapple and $ 9,121.2 for carrots. The cumulative present worth was $ 62,232.7 for pineapples and $ 57,836.3 for carrots. The payback period was found to be 1.5 years and 1.6 years for pineapple and carrots, respectively. The LCA revealed that steel materials had higher environmental impact items in material extraction and fabrication compared to aluminum materials for both the midpoint and endpoint categories. Based on techno-economic TEA and LCA assessments, the fabricated solar dryer is economically feasible and environmentally friendly. Solar dryers integrated with soapstone showed potential as sustainable and efficient solutions for reducing post-harvest losses and enhancing food quality and security in resource-constrained regions like Sub-Saharan Africa.

Yours Sincerely,

Prof. Hans Komakech
Ag: Dean