

# The economic impact of error in rice moisture measurement

Author: **Haslina Abdul Kadir**  
Technical Director, National Metrology Institute of Malaysia

## Key messages

- Rice moisture content affects decisions in grain harvesting, drying, storage, handling and marketing.
- Metrological control and measurement traceability of rice moisture measurement should be established.
- Better regulation of rice moisture meters used in trade are needed in Malaysia.
- Measurement traceability plays a vital role in ensuring the accuracy and reliability of rice moisture measurements, which in turn impacts the quality and market value of the rice.

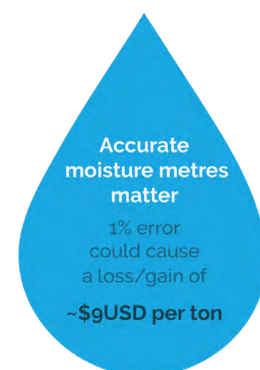
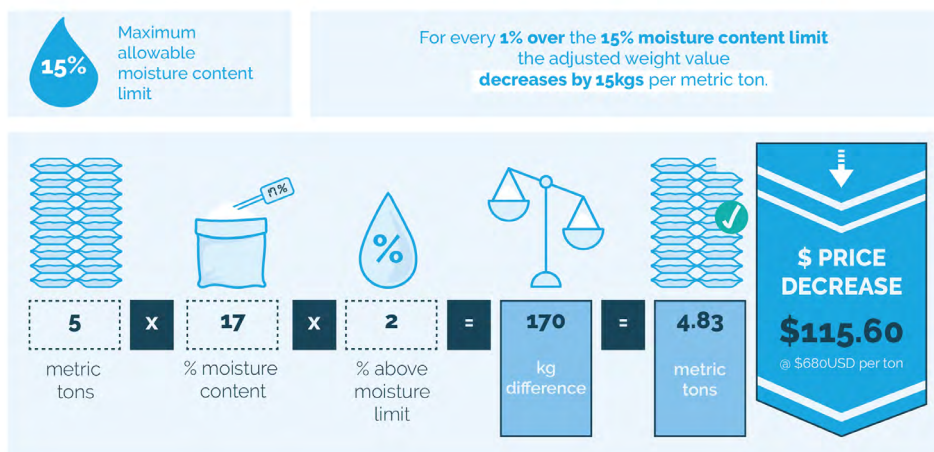
## What's the issue?

Rice is a global staple food; the primary source of complex carbohydrates for over half the world's people. <sup>1</sup> In all markets, rice is bought and sold by weight, and the most important factor in defining that weight is moisture content (MC) – the weight of water contained in rice, expressed as a percent. Moisture control in rice is crucial to the quality of the final product. Improper moisture levels at different stages in rice production can result in harvesting loss, spoilage of grain in storage, higher drying costs, loss of quality, and weight loss (if sold too dry). <sup>2</sup>

There are two main methods to measure moisture content. The primary method is based on weight measurements, and involves drying rice samples via an oven or an infrared moisture balance. The secondary method uses an electronic instrument known as a moisture meter, to measure the electrical characteristics of the rice. Moisture meters are popular because they are practical to use, and require only small samples, but they require frequent calibration to ensure accuracy.

Knowledge of the MC of rice is also vitally important to domestic and international trade, due to its strong influence on the price. In trade, the maximum allowable moisture limit of rice is 15%. For rice that exceeds that moisture limit, a set metric is used to calculate its future weight loss (which will happen naturally as the rice is stored), as this has an impact on the price paid. This metric is 15 kg per metric ton for each 1% moisture over the moisture limit. In addition, if rice moisture meters have a 1% error, that equates to a loss or gain of ~US\$9 per ton.

The accuracy of rice moisture measurement directly contributes to fair trade. As a result, measurement instruments for rice moisture are under legal metrological control in many economies to ensure fair trade among producers, traders, exporters, importers, and customers. These controls stipulate the need for regular calibration, verification, and certification of moisture meters, to ensure and maintain their accuracy. Despite producing around 1.68 million tons of rice per year, Malaysia does not have specific regulations for rice moisture measurement. <sup>4</sup>



Accurate moisture metres matter  
1% error could cause a loss/gain of ~\$9USD per ton

## Why is this important?

In 2023/2024, the world rice production was estimated to be 518.14 million metric tons.<sup>3</sup> Errors in rice moisture measurement have a significant economic impact, so it is essential that the rice industry prioritize accurate and reliable moisture measurement practices through the implementation of robust quality control measures. By ensuring that accurate, precise, and consistent moisture readings are taken throughout the production and distribution process, the impact on trade can be minimized.

While manipulation of rice moisture meters to misrepresent the moisture content of rice does occur, this situation can be overcome with a good metrological control at a national level. This means that all rice moisture meters must be calibrated and validated frequently and periodically to catch any potential error. In addition, the use of instruments that have been tested against national or international standards is integral to ensuring that rice moisture meters are reliable and trustworthy.



## The role of metrology

Metrology provides a common, internationally-recognised language for expressing measurements. At the heart of this is the concept of traceability – an unbroken chain of calibrations that connect measurements taken in the field to international standards.

Certified reference materials (CRMs) play a key role in establishing a sound traceability system. The National Metrology Institute of Malaysia (NMIM) has developed certified reference materials for the moisture content of rice. CRMs are available for rice with a moisture range of 12-16%, and for paddy (unprocessed rice, with the husk intact) with a moisture range of 14-20%.

The performance of the laboratory or verifier in measuring the moisture content can be evaluated accurately through accuracy-based proficiency testing using these CRMs.

Instrument testing based on international standard, OIML R59, carried out by the National Metrology Institute helps in determining the measurement accuracy of the instrument and whether the instrument retains this accuracy under a range of environmental and operating conditions.

## What should policy makers do?

It is important for all countries to establish metrological controls to monitor and regulate rice moisture measurement practices. This involves implementing a set of standards and protocols to ensure the accuracy, reliability, and consistency of the measurements.

Thailand, through the Central Bureau of Weights and Measures (CBWM), has provided good governance of legal metrology traceability systems, and standards for calibration, verification, and inspection of rice moisture meters. This approach is critical for establishing the quality control and trade of rice, as moisture content significantly affects its storage, processing, and market value.

For policymakers operating in rice-producing economies, the following steps are recommended to establish an internationally-recognised traceability system of rice moisture measurement:

1. Establish regulations and guidelines for the use of calibrated moisture meters that meet existing international standards, as well as procedures for regular checks and verification of these meters
2. Establish the maximum permissible error for inspection and verification of rice moisture meters.
3. Establish effective enforcement mechanisms to ensure compliance with established regulations.

## Local example: Thailand

Thailand is a major producer and exporter of rice on the global market, yielding 20 million tonnes of rice in the financial year 2022-23; a 2% increase over 2021-22.<sup>3</sup>

In Thailand, every 1% of rice moisture content beyond the agreed limit (15% MC) equates to a 1.5 % drop in the price per ton. Based on the country's most recent figures, that could mean a loss of about 120 million USD/year to the economy.<sup>2</sup> The Central Bureau of Weights and Measures (CBWM) established metrological control of rice moisture measurement in 2001.<sup>5</sup>

In 2004, they issued a ministerial regulation based on OIML R 59:1984, an international standard focused on moisture measurement in cereal grains and oilseeds.<sup>6</sup> This regulation states that rice moisture meters used for commercial transactions should be verified by Weights and Measures Officers every two years. During this period, officers can inspect rice moisture meters to be used in the marketplaces to determine whether their accuracy still complies with the regulation. Rice moisture meters that fail their inspection are prohibited from use until repaired and re-verified.

The Thai CBWM subsequently established a traceability system, calibration standards, and verification and inspection processes for rice moisture meters (Fig.1). Between 2017 and 2023, approximately 2,600 units of moisture meters were verified, which suggests that people working in Thailand's rice industry have an awareness of the importance of rice moisture measurement in trading.

In addition, manipulation of moisture meters in rice trading in Thailand decreased by 50% in two years, between 2021 to 2023.<sup>7</sup> This highlights the importance of good governance of legal metrological control in preventing fraud and protecting consumers from being deceived by inaccurate measurements. Metrological control promotes fair trade practices, enhances market confidence, and contributes to the overall quality assurance of rice.

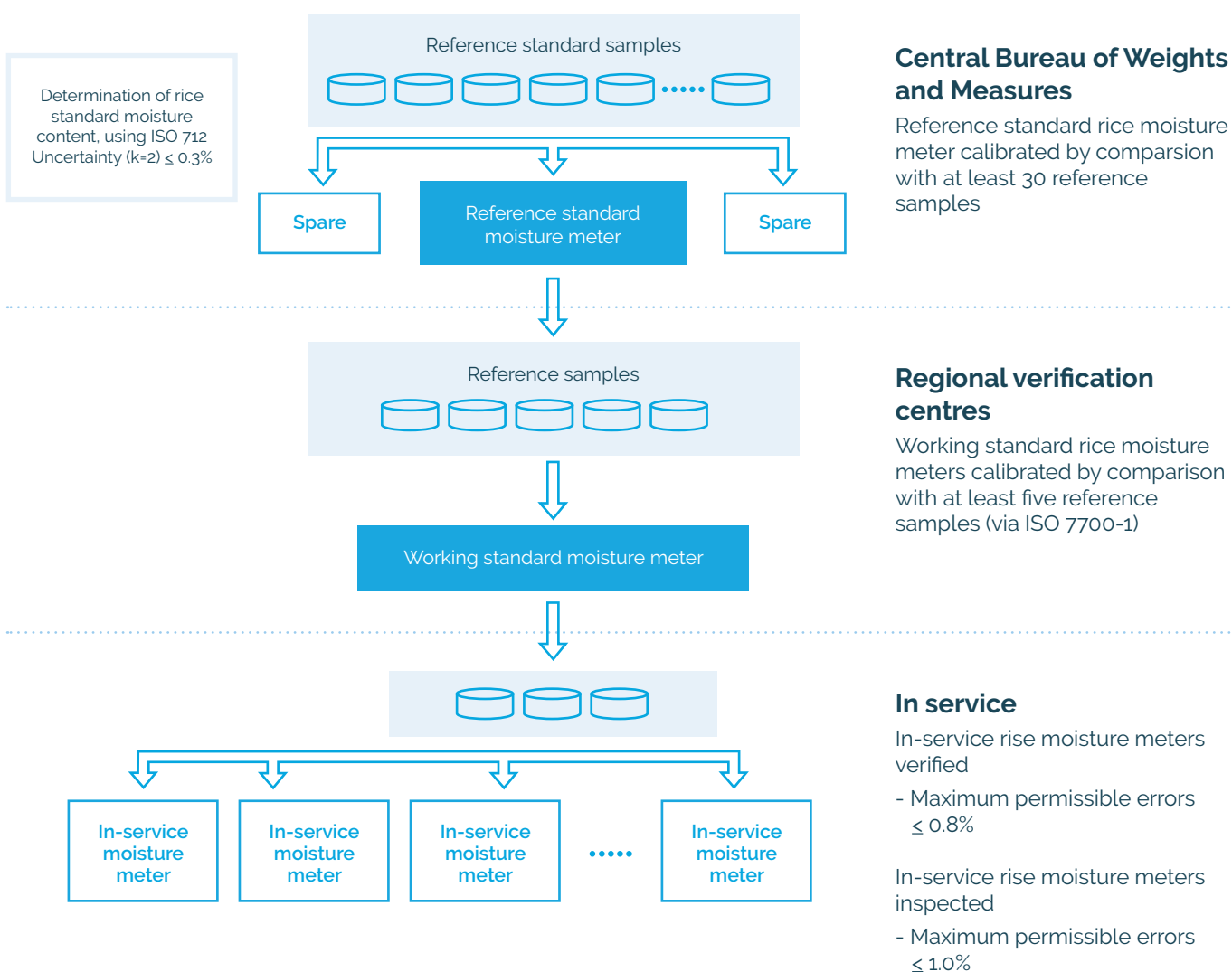


Fig. 1 Traceability chart for rice moisture content measurement in Thailand<sup>3</sup>

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- 7 Data provided via personal correspondence between the National Metrology Institute of Malaysia and Thailand's Central Bureau of Weights and Measures.