



UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

Bureau
International des
Poids et
Mesures



Food Security and Economic Stability for Thailand: Moisture Content in Rice

NIMT and private industry collaborate to develop reference materials for metrologically traceable rice moisture determinations, ensuring fair trade and mitigating economic losses

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The Challenge

The agricultural sector in Thailand faces a massive challenge in maintaining the quality of its 20 million tons of annual rice output.¹ This challenge directly supports efforts to reduce post-harvest losses by reducing food spoilage and optimizing rice production, a vital staple crop for the nation. Moisture damage to stored rice leads to mold growth, musty odors, discoloration, and increased insect infestation, often rendering it unusable (see **Figure 1**). High humidity causes rice to absorb water (hygroscopic behavior), leading to a "wet" surface, the production of fungal toxins, and a significantly reduced shelf life. Optimal storage requires airtight, cool, and dry conditions, ideally with a moisture content below 14 %, to prevent spoilage.² Before the metrological intervention, moisture meter verification was a time-consuming process that required specialist skills and methods rarely available to end-users, posing a risk of unreliable data in the trade of a vital national commodity.

The specific measurement gap was the lack of an accessible, rapid method for reliably measuring moisture content in both 'rice' (without shell) and 'paddy' (with shell). Inaccurate measurements led to severe economic consequences, including significant financial losses for farmers and traders, as prices are directly tied to moisture levels. A failure to measure accurately meant either grain spoilage or an unfair 1.5 % drop in price for every 1 % error in moisture content. The management of rice stockpiles and disputes over grain quality and spoilage have resulted in significant economic challenges and heightened social pressures.³ These outcomes underscore the urgent need for objective and reliable metrological standards that safeguard food security, ensure equitable trade, and prevent manipulation within market systems.

¹ USDA Foreign Agricultural Service. (2025). Grain and Feed Annual: Thailand (Report No. TH2025-0011). Bangkok: USDA GAIN Report. Available at: <https://www.fas.usda.gov/data/thailand-grain-and-feed-annual-2025>

² How Humidity Levels Affect the Storage Life of Basmati Rice. <https://basmatipakistan.com/basmati-rice-storage-humidity/>

³ Taylor, J. L. (2016, February 17). Finding the grains of truth in Thailand's spoiled-rice scandal. Asian Currents: Asian Studies Association of Australia (ASAA). <https://asaa.asn.au/finding-grains-truth-thailands-spoiled-rice-scandal/>



Figure 1. A comparison of rice quality: Fresh, high-quality rice (top) contrasted with spoiled, moisture-damaged rice showing signs of mold and discoloration (bottom).

The Solution

NIMT, the National Metrology Institute for Thailand, developed the country's first metrologically traceable Certified Reference Materials (CRMs) for rice moisture. Since 2017, this activity has involved collaboration among NIMT, which led the development of rice moisture CRMs and ensured SI traceability; Industry Partner (Kett): A leading manufacturer of moisture meters used in agricultural testing, providing equipment and manufacturer-side technical collaboration; Thailand's national quality infrastructure (NQI) consortium including regulatory bodies like the Central Bureau of Weights and Measures (CBWM) and participating testing laboratories to validate CRMs and align with national standards.

Traceability to the SI was ensured through primary standards of mass and temperature using metrologically valid procedures.

The production and characterization of the CRMs were conducted in accordance with the principles of ISO Guide 35:2017 to ensure homogeneity and long-term stability. The entire process is integrated within the NIMT quality management system, which is accredited to ISO/IEC 17025:2017. These materials are now used in interlaboratory comparison exercises between NIMT and various designated organizations and stakeholders.

The evidence base for this intervention includes interlaboratory comparison data within Thailand and national agricultural statistics from the USDA Foreign Agricultural Service.^{4,5,6} Data quality was ensured through rigorous uncertainty evaluations and characterization of the CRMs performance.⁷ The reference materials successfully passed homogeneity and long-term stability testing, with certified values valid for 3 months in accordance with ISO Guide 35: 2017 (see **Figure 2**). This ensures that every grain of the standard rice produced has uniform moisture content, with any deviations remaining within the defined measurement uncertainty, thereby providing confidence in the reliability of the calibration process. The project references international standards, including ISO 712⁸ for the reference method of determining moisture content in cereals, ISO 7700-1⁹ for checking moisture meter performance, and CODEX STAN 198-1995,¹⁰ which complements ISO standards by providing internationally recognized food safety and trade specifications.

Over the past year, NIMT has carried out technology transfer activities by organizing training sessions for the Rice Department, Central Bureau of Weights and Measures, and calibration laboratories, among others. In addition, rice and paddy with known, stable values were distributed to laboratories, which measured moisture content using ISO 712 and returned results to NIMT for comparison. This interlaboratory process confirmed competence, verified procedures, and provided a foundation for expanding capabilities to support the calibration of rice moisture meters.

⁴ The economic impact of error in rice moisture measurement," Metrology Asia Pacific, Policy Brief, 2024. Link (<https://metrologyasiapacific.com/assets/Uploads/Economic-impact-of-error-in-rice-moisture-measurement.pdf>) Global Agricultural Information Network report from the US Department of Agriculture Foreign Agricultural Service (FAS), 2022. <http://www.world-grain.com>

⁵ Global Agricultural Information Network report from the US Department of Agriculture Foreign Agricultural Service (FAS), 2022. <http://www.world-grain.com>; T. Sinhaneti, T. Keawprasert, P. Punttharo, and W. Triarun, Quality Assurance of Rice and Paddy Moisture Measurements in Thailand, Int. J. Thermophys., vol. 38, p. 154, 2017.

⁶ T. Sinhaneti, T. Keawprasert, and C. Boonyakong, Development of CRM for quality assurance of rice moisture measurement in Thailand, presented at TEMPMEKO 2019, Chengdu, China, June 2019.

⁷ T. Sinhaneti, T. Keawprasert, and C. Boonyakong, Development of CRM for quality assurance of rice moisture measurement in Thailand, presented at TEMPMEKO 2019, Chengdu, China, June 2019.

⁸ International Organization for Standardization. (2024). Cereals and cereal products — Determination of moisture content — Part 1: Reference method (ISO Standard No. 712-1:2024). Available at: <https://www.iso.org/standard/85395.html>

⁹ International Organization for Standardization. (2008). Food products — Checking the performance of moisture meters in use — Part 1: Moisture meters for cereals (ISO Standard No. 7700-1:2008). Available at: <https://www.iso.org/standard/44610.html>

¹⁰ Codex Alimentarius Standard for Rice (CODEX STAN 198–1995, Rev. 1–2009) – Available at: <https://www.fao.org/fao-who-codexalimentarius/codex-texts/list-standards/en/>

(a)



(b)

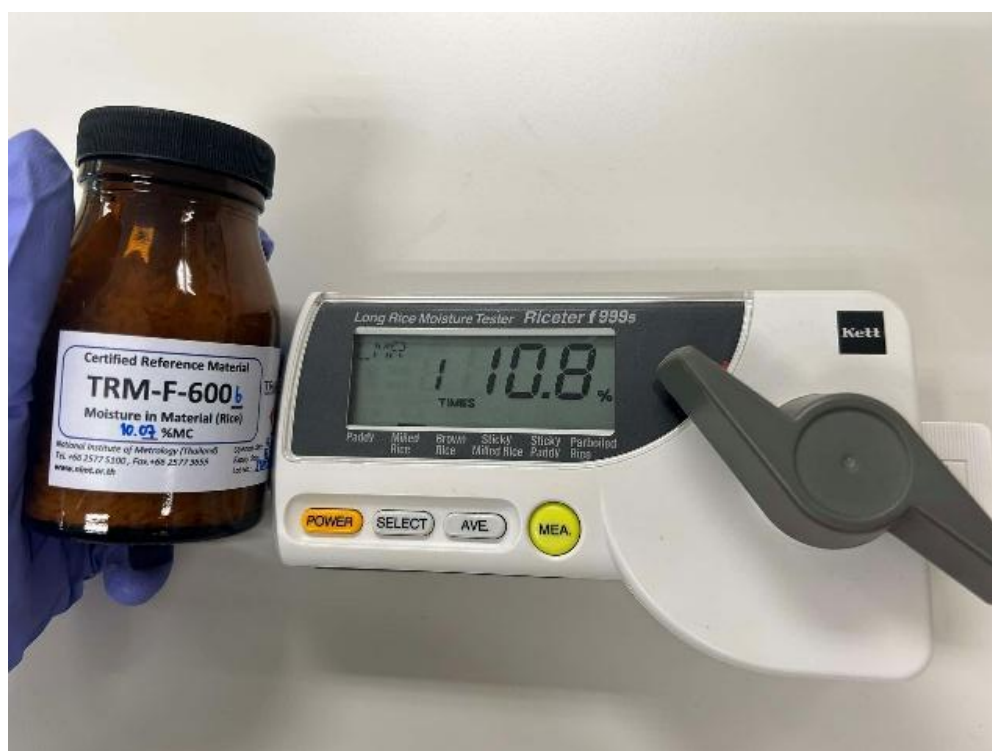


Figure 2. (a) Preparation of the rice CRM contents for moisture analysis via a Kett PM450 moisture tester. (b) A unit of rice CRM (with a value assignment of 10.07 %) side by side with the results for the moisture analysis.

A Quantifiable Impact

The primary measurable improvement across the measurement range for Thai rice (10 %–20 %) and Thai paddy (10 %–26 %) was a 0.2 % uncertainty in moisture content. Quantitatively, this enabled industry to meet its 0.8 % target requirement¹¹ for moisture meter validation, a significant improvement over previous baseline methods that were slow and less reliable. This transition gives the industry confidence in its measurements and helps mitigate a potential annual loss of 120 million USD to the Thai economy.

These results support fair trade regulations and national agricultural strategies by providing a metrologically traceable CRM that ensures accuracy in commercial transactions. The case demonstrates the value of metrology and industry collaboration, demonstrating how an NMI can work with private distributors to provide the underlying services that support and stabilize a major economic sector. It highlights the necessity of sustained investment in metrology to maintain trust in national and international trade.

Acknowledgments. Information is drawn from the National Institute of Metrology, Thailand (NIMT), and the official case study "Measuring the moisture content of rice,"¹² established by APMP and APLMF.

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¹¹ Asia-Pacific Legal Metrology Forum (APLMF). APLMF guide document on rice moisture measurement, Wellington, New Zealand: APLMF Secretariat, Ministry of Business Innovation & Employment, 2017.

¹² The economic impact of error in rice moisture measurement," Metrology Asia Pacific, Policy Brief, 2024.
<https://metrologyasiapacific.com/assets/Uploads/Economic-impact-of-error-in-rice-moisture-measurement.pdf>