

## World Metrology Day 2023 Article

### Measurements Supporting the Global Food System



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# TABLE OF CONTENTS

<b>Section</b>	<b>Page</b>
<b>INTRODUCTION.....</b>	<b>1</b>
<b>THE IMPORTANCE OF MEASUREMENT IN THE FOOD GLOBAL SYSTEM.....</b>	<b>3</b>
<b>THE VALUE OF METROLOGY PRACTITIONERS .....</b>	<b>4</b>
<b>WHAT THE EXPERTS SAY .....</b>	<b>5</b>
<b>SUMMARY .....</b>	<b>6</b>
<b>REFERENCES.....</b>	<b>7</b>
<b>APPENDIX.....</b>	<b>9</b>

## INTRODUCTION

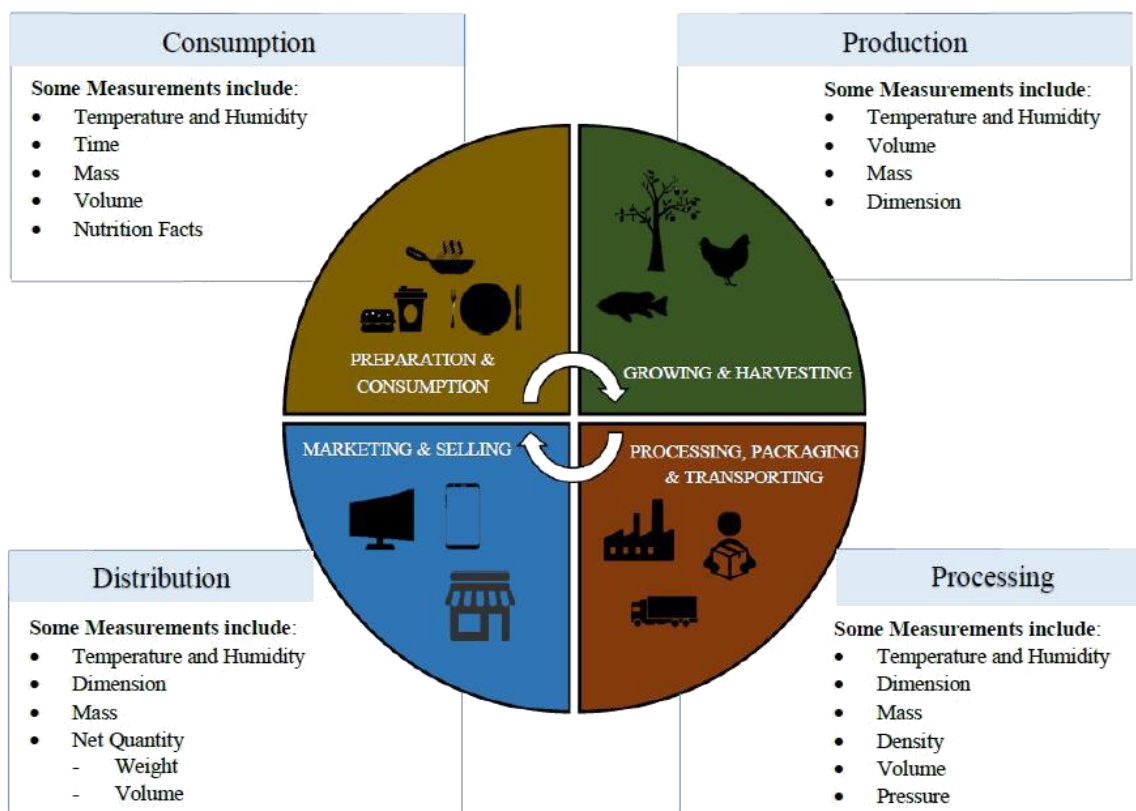
Stop! Before you take another bite of that burger, or sip on your drink or open that pack of your favourite snack, have you ever considered the metrological support – no I’m not speaking about the weather, which is vital but rather, metrology – that would have gone into providing this quality end product to you, as the consumer?

In this article we explore the importance of measurement within the global food system. What is the food system you ask? Well, it encompasses all activities, processes, and infrastructure involved in producing food for consuming, including growing, harvesting, processing, packaging, transporting, marketing, selling, cooking, consuming and increasingly disposal. It also includes inputs and outputs generated along the chain, as well as public officials, civic organizations, educators, and researchers who influence it [1].

“And what about metrology, what is it?” you may be asking. For those who may not be familiar with the term, metrology is derived from the Greek word “*metron*” which means measure while the suffix –logia from Latin (or –logy in English) mean the science or study of [2]. In essence it is the study of measurement or more succinctly the science of measurement. There are three (3) categories of Metrology: Scientific Metrology which is concerned with establishing and accurately propagating the base units of measurement globally. It sets the standards for the definite magnitude of a physical quantity. Industrial Metrology or Applied Metrology deals with the calibration, maintenance, and quality control of measurement instruments used in the industry. Legal Metrology is responsible for the regulatory aspects of measurement and measurement instruments towards ensuring legal transactions can be trusted [3].

Figure 1 below illustrates a food system and some of the measurements that can be performed from production to consumption.

# FOOD SYSTEM



**Figure 1:** A food system and some of the measurements typically can be performed

In the subsequent sections of this article you will understand the importance of measurement to the food global system, the value and importance of the work done by metrology practitioners as it relates to global food challenges and demonstrations of how measurements assist in solving food challenges. You will also read the thoughts of experts in the field of metrology and quality in Trinidad and Tobago on this topic.

Now, to answer the question asked at the beginning of this introduction as to whether they considered measurements involved, prior to consuming their intended culinary choice. An unscientific poll was conducted among our work colleagues, friends and families and of the forty-five (45) persons that participated thirteen (13) persons responded “Yes” while the other thirty-two (32) responded “No”. It can therefore, be concluded that the majority of sampled consumers generally do not consider the measurements that they depend on as they consume their food.

# **THE IMPORTANCE OF MEASUREMENT IN THE FOOD GLOBAL SYSTEM**

Measurement is essential for several aspects of the global food system, and it plays a central part in supporting it. Why is this important? Food is essential for human survival and with the world's population reaching 8 billion at the end of 2022 matched with the challenges of climate change, the demand for safe and high-quality food has never been greater and with limited resources, it's important to see to it that every aspect of the food industry is operating as efficiently as possible [4].

One of these is Ensuring food safety. Accurate measurement is essential for ensuring that food products are safe for consumption. Measurement is used in various ways to test for contaminants such as bacteria, pesticides, and heavy metals, and to ensure that food products meet safety standards set by regulatory agencies. Another way measurement is important is that it is involved with improving food quality. It is also used to determine the quality of food products, including factors such as nutrient content, flavour, and texture.

Accurate measurement is essential for ensuring that food products meet consumer expectations and are of a high quality. Measurement is used to enhance production processes and improve efficiency in the food supply chain. For example, measurement can be used to monitor crop growth and yield, to improve irrigation and fertilisation practices, and to ensure that food processing operations are running at peak efficiency. This information helps to optimize inventory management, reduce waste, and improve logistical planning.

Measurement also plays a key role in Facilitating international trade. Global food trade relies on consistent measurements to ensure that products meet international standards and regulations to cross borders with minimal restrictions. For example, measurements are used to determine the quality and quantity of food products for import and export purposes, not to mention taxation, environmental safety and profits margins.

Overall, accurate and consistent measurement is essential for supporting the food global system, ensuring food safety, improving food quality, supporting supply chain efficiency, and facilitating trade.

## **THE VALUE OF METROLOGY PRACTITIONERS**

Metrology practitioners play a vital role in ensuring the accuracy and consistency of measurements in the food system. They develop and maintain the measurement infrastructure, including the units of measure, unit systems, and quantity systems used in scientific, industrial, and legal metrology.

With the increasing demand for safe and high-quality food, their work has become more important than ever. These professionals offer guidance to laboratories on how to ensure accurate and reliable measurements, and they are responsible for maintaining and calibrating the instruments used to measure various parameters in food production and processing. This includes temperature, pressure, and mass to name a few [5].

Using traceable measurements, they calibrate and adjust specialized equipment to ensure they are accurate and operating within the desired specifications. Ensuring that the tools used for food testing and inspection are accurate and reliable is paramount for food safety [6]. Failing to calibrate equipment can result in inaccurate measurements, incorrect product formulations, and safety hazards, among others. For example, an improperly calibrated thermometer used to measure the temperature of cooked meat may indicate a lower temperature than the actual temperature, leading to undercooked meat and food-related illness. Similarly, an incorrectly calibrated scale used to measure ingredients in a recipe may result in incorrect formulations, causing product defects, wastage, even recalls, not to mention damaged reputations [7], [8], [9].

Metrology practitioners also collaborate with researchers, industry, and regulatory agencies to develop new measurement methods, improve existing ones, and address emerging food challenges. For example, they may develop new methods for detecting food contaminants or improving the accuracy of measuring nutrient content in food products. Practitioners in the field of legal metrology, ensure that trade is fair and accurate and that consumers get exactly what they have paid for. Decisions made based on measurement results affect economic and personal well-being, highlighting the importance of accurate and transparent measurements. Consistent and reliable measurements instil confidence in consumers, businesses, and regulators, enabling a well-functioning society. Legal metrology is instrumental in establishing trust and transparency in the market, upholding consistent product quality [10], [11], [12].

Having consistent product quality is essential because customers expect products to look, taste, and feel the same each time they purchase them. The work of these experts is central to supporting a safe, efficient and sustainable food system.

## WHAT THE EXPERTS SAY

In this section, we will discuss the importance of measurement in the food industry. We conducted interviews with two industry professionals - one from the quality department of a leading beverage company and the other a maintenance technician from a global company specializing in water hygiene and infection prevention. In addition, we obtained responses from two individuals from the TTBS Metrology Division who answered a questionnaire (see Appendix for questions).

Our interviews revealed that measurement plays a crucial role in ensuring quality and safety standards are met in the food industry. For instance, a leading beverage company in Trinidad uses a balance to weigh dried ingredients before they are mixed into larger vessels. Precise measurements are crucial in achieving standardized taste, texture, and appearance, as well as determining nutritional values of beverages. These balances are calibrated annually by the Trinidad and Tobago Bureau of Standards (TTBS) and periodically checked by the beverage company's technicians, who maintain control charts to detect any drift or anomalies between calibrations.

Measurement is also important in the background processes of the food industry. A maintenance technician from a global company specializing in water hygiene and infection prevention recounted a recall of a beverage in July 2019 due to under-pasteurization [13]. Pasteurization is a critical process that eliminates pathogens and extends the shelf life of a product. Temperature and time are essential metrological components of pasteurization, and miscalculations of these factors can result in costly recalls.

The TTBS Metrology Division, comprising officers and technicians, plays a vital role in building the SI-based measurement systems and infrastructure in Trinidad and Tobago. Proper measurements help mitigate food challenges in small and developing nations, such as the Caribbean islands, where abnormal rates of hypertension and diabetes are prevalent. While the public is generally aware of the importance of measurements at points of sale, they may not be aware of the system needed to assure proper measurements. The statement "Measurements Supporting the Food Global System" encompasses measurements throughout the food supply chain, including food production, distribution, processing, marketing, storage, and consumption. It is crucial to support these measurements to maintain a healthy, well-fed society.

The Metrologist's role in measurement is to ensure that accurate and trusted measurements are made everywhere, which is critical to quantifying and verifying the quality of goods and services. In the context of food, measurements can assist with phytosanitary requirements for export safety and acceptance, temperatures for storage, processing and preparation of food, and mass measurements support the shipping, selling and disposal of food products in trade.

While the general public may be less aware of the importance of proper measurements when it comes to food, public awareness campaigns utilizing all available media can help raise this awareness.

Everyone ought to know the crucial role measurements play in supporting every aspect of a sustainable global food system and trade, from food production to processing, distribution, storage, consumption and disposal.

## **SUMMARY**

Metrology is a crucial component of the global food system, providing accurate measurements for every aspect of the industry. It ensures that processes such as agriculture, manufacturing, quality assurance, health and safety, and distribution are carried out safely, sustainably, and efficiently. Measurements such as temperature, volume, time, weight, density, humidity, and dimensions all contribute to ensuring the processes associated are carried out in a safe, sustainable and efficient manner while protecting and benefitting all involved in the global food system. With an increasing world population and climate change, the demand for food that is safe and of the utmost quality has never been greater. Thus, good measurements are essential for providing reliable food for citizens worldwide. In conclusion, the role of metrology in the global food system cannot be overstated, and its importance will only continue to grow in the coming years.



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## APPENDIX

Below is an images of the question asked to the employees of the Metrology Division of the Trinidad and Tobago Bureau of Standards.

A.



**Figure:** Image of poll done via WhatsApp

B. These were the six question asked:

1. What is your current occupation or job title?
2. Can you describe your profession or field of expertise?
3. Can you share how this role in measurement helps support quality / quantity of food in Trinidad and Tobago.
4. Can you state any food challenge(s) that proper measurement can assist with for small and developing nations such as the Caribbean islands?
5. Do you think the general public is aware of the importance of proper measurements when it comes to food? If no, do you have any suggestions which can improve this situation?
6. Can you share in your own words your thought on the statement "Measurements Supporting the Food Global System"?