THE UNITED REPUBLIC OF TANZANIA
NATIONAL AUDIT OFFICE

PERFORMANCE AUDIT REPORT ON IMPLEMENTATION OF CONTROL ACTIVITIES ON MEASUREMENTS

CONTROLLER AND AUDITOR GENERAL

MARCH, 2022

About National Audit Office

Mandate

The statutory duties and responsibilities of the Controller and Auditor General are given under Article 143 of the Constitution of the URT of 1977 and in Sect. 10 (1) of the Public Audit Act, Cap 418.

Vision, Mission and Core Values

Vision

A credible and modern Supreme Audit Institution with high-quality audit services for enhancing public confidence.

Mission

To provide high-quality audit services through modernization of functions that enhances accountability and transparency in the management of public resources.

Motto: "Modernizing External Audit for Stronger Public Confidence"

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ii. Independence and objectivity
iii. Professional competence
iv. Integrity
v. Creativity and Innovation
vi. Results-Oriented
vii. Teamwork Spirit

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- ✓ Helping to improve the quality of public services by supporting innovation on the use of public resources;
- ✓ Providing technical advice to our clients on operational gaps in their operating systems;
- ✓ Systematically involve our clients in the audit process and audit cycles; and
- ✓ Providing audit staff with appropriate training, adequate working tools and facilities that promote their independence.

PREFACE

Section 28 of the Public Audit Cap 418, give mandate the Controller and Auditor General to carry out Performance Audit (Value-for-Money Audit) for the purposes of establishing the economy, efficiency and effectiveness of any public expenditure or use of public resources in the Ministries, Departments and Authorities (MDAs), Local Government Authorities (LGAs) and Public Authorities and other bodies which involves enquiring, examining, investigating and reporting as deemed necessary under the circumstances.

I have the honour to submit to Her Excellency, Hon. Samia Suluhu Hassan the President of the United Republic of Tanzania, and through her to the Parliament, a Performance Audit team Report on the Implementation of Control Activities on Measurements.

This report contains conclusions and recommendations that directly concern the Ministry of Investment, Industry and Trade (MIT), the Weights and Measures Agency (WMA) and Tanzania Bureau of Standards (TBS).

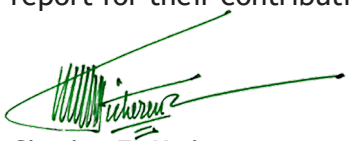
Management of MIT, WMA and TBS were given opportunities to scrutinize the factual contents and comment on the draft report. I acknowledge that, the discussions with the Ministry of Investment, Industry and Trade (MIT), the Weights and Measures Agency (WMA) and Tanzania Bureau of Standards (TBS) have been very useful and constructive.

My office intends to carry out a follow-up at an appropriate time regarding actions taken by the MIT, WMA, and TBS and in relation to the recommendations given in this report.

In completion of the assignment, the office subjected the report to the critical reviews of Mr. Ishigita Lucas Shunashu - an Assistant Lecturer, Metrology & Standardization Department, the College of Business Education and Mr. Peter Samuel Masinga - retired Assistant Commissioner for Weights and Measures Agency who came up with useful inputs for improving this report.

This report has been prepared by Mr. Staford Kazyoba - Team Leader and Mr. Alfa Tandise – Team Member under the supervision and guidance of Mr. Michael Malabeja – Chief External Auditor, Mr. James G. Pilly – Assistant Auditor General and Mr. George Haule –Ag Deputy Auditor General.

I would like to appreciate my staff for their inputs in the preparation of this report. I also extend my appreciations to the entities that reviewed this report for their contribution and fruitful interactions with my office.



Charles E. Kichere
Controller and Auditor General,
Dodoma.
March, 2022.

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LIST OF ACRONYMS AND ABBREVIATIONS

BIPM	Bureau International des Poids et Mesures / International Bureau of Weights and Measures
BST	Bulk Storage Tanks
CBE	College of Business Education
CIPM	International Committee for Weights and Measures (CIPM, Comité International des Poids et Mesures)
CIPM MRA	Mutual recognition arrangement of national measurement standards and of calibration and measurement certificates issued by national metrology institute
DN	Diameter Nominal
ERB	Engineers Registration Board
EU	European Union
FMS	Fiscal Metering System
FST	Fixed Storage Tanks
ILC	Inter Laboratory Comparison
INTOSAI	International Organization of Supreme Audit team Institutions
ISO	International Organization for Standardization
ISSAI	International Standards of Supreme Audit team Institutions
KOJ	Kurasini Oil Jet
LATRA	Land Transport Regulatory Authority
MIT	The Ministry of Investment, Industry and Trade
ML	Metrology Laboratory
MTG	Manual Tank Gauging
NEMC	National Environment Management Council
NMI	National Metrology Institute
OIML	Organisation Internationale de Métrologie Légale (International Organization of Legal Metrology)
OMCs	Oil Marketing Companies
OSHA	Occupational Safety and Health Administration
PBPA	Petroleum Bulk Procurement Agency
PO-PSM & GG	The President's Office, Public Service Management and Good Governance
RMO	Regional Metrology Organization

SBM	Single Buoyance Mooring
SI Unit	International System of Units
TAEC	Tanzania Atomic Energy Commission
TANROADS	Tanzania National Roads Agency
TBS	Tanzania Bureau of Standards
TBT	Technical Barriers to Trade
TMA	Tanzania Meteorological Agency
UDSM	University of Dar Es Salaam
UTI	Ullage Temperature Interface
VTV	Vehicle Tankers Verification
WMA	The Weights and Measures Agency

DEFINITION OF TERMS

Metrology	Science relating to accurate and reliable measurements. It is science of measurement and its application. It includes all theoretical and practical aspects of measurement, whatever the measurement uncertainty and field of application.
OIML	an "international standard-setting body" in the sense of the World Trade Organization's Technical Barriers to Trade (TBT) Agreement [10]
Proving Tanks	These are the specialized precision open volumetric calibrating measures. They enable on site calibration of liquid Flow Meters, Master Meters, and vehicle tanks with high degree of accuracy and reliability.
Traceability of Standards	Refers to the value of a standard, where it can be related to stated references (national or international standards) through an unbroken chain of comparisons, all having stated uncertainties (ISO)[1]
Approved pattern	Type (pattern) approved based on the review of the type of evaluation report that the type of a measuring instrument complies with the relevant statutory requirements and results in the issuance of the type of approval certificate. ***Refer Appendix 5*** example of the measuring instruments.

[1]https://www.google.com/search?client=firefox-b-d&q=definition+of+Traceability+of+standards

Standards	Fundamental reference for a system of weights and measures, against which all other measuring devices are compared.
National Standards	National Reference Standards of weight and measure maintained by the Tanzania Bureau of Standards under Section 4 of the Standards Act, 2009.
Secondary Standards	Standard equipment used to compare and if necessary correct and adjust working standards before signing their certificates. They are compared with the National Standards and if necessary be corrected and adjusted by the Tanzania Bureau of Standards or any other competent institution as the Minister for investment, industries and trade may direct.
Working standards	Standards which are standardized by comparison with Secondary Standards kept for the purpose of verifying trades, weighing, or measuring instruments, weight, or measure[2]
Accreditation	Recognition of technical competence
Certification	Conformity with specified requirements
Pre-packages	Combination of a product and the packing material in which it is prepacked
Testing	Analysis or assessment for properties, values, and performance

[2] PART I of Preliminary Provisions of Weights and Measures Act.

Verification	Examination testing and marking and/or issuing of a verification certificate, which ascertains and confirms that the measuring instrument complies with the statutory requirements.
Re-verification	Any verification of a measuring instrument after a previous verification and including; mandatory periodic verification and verification after repair
Inter Laboratory Comparison	Organization, performance, and evaluation of measurements or tests on the same or similar items by two or more laboratories or inspection bodies in accordance with predetermined conditions.
Intra Laboratory Comparison	Conducted when several analysts or technicians within an organization perform testing or calibrations on the same or similar artefact, using the same method, under specified, controlled conditions.

EXECUTIVE SUMMARY

A proper application of Weights and Measures practices is critical in order to ensure that there is clarity and certainty about measures used. It ensures that producers, traders, and consumers are protected, and the government collects revenues entitled to it.

In recent years because of the rapid development, increased rational decisions which are supported by accurate measurement readings from digitalized measuring instruments, there has been a notable complaint from the producers and consumers concerning errors of the weight and measure due to the misbehaviors of measurement equipment. This in one way is because of weak enforcement of the regulations governing compliance to standard weights and measures. For example, in energy sector, less than 30% metrological control has been implemented such as the verification of electrical meters, natural gas meters and petroleum meters. This might deny the fair trade, restrain transparency in energy transaction and hinder the removal of barriers to trade especially in the natural gas.

Such complaints created a demand for ensuring that consumers, businesses, and manufacturers are protected from unfair practices through the application of accurate weights and measures. This Audit was motivated based on these grounds.

The main Audit objective was determining whether the Weights and Measures Agency (WMA) and Tanzania Bureau of Standards (TBS) adequately implemented control activities on legal, scientific, and industrial metrology to protect consumers on issues related to measurements and whether the Ministry of Investment, Industry and Trade (MIT) effectively monitored the implementation of such activities. The Audit covered four financial years 2017/2018 to 2020/21. The selected period enabled Auditors to establish trend of executed metrology activities and develop reliable conclusions.

Main Audit Findings

WMA did not Develop a Formal Database for Keeping Record of Standards and Performance

This Audit team found that, WMA did not develop a formal database to capture the performance status of secondary standards. In addition to this, there was no official database for the working standards in all ten visited WMA regional offices. This was because WMA did not assess the performance of their operations to identify the gaps and areas of improvement. Because of this, the status of standards was only recorded in specific times when inventory exercise was conducted. As a result, it has been difficult to access the status of standards both at WMA HQ and at WMA regional offices.

WMA did not Timely Compare Secondary Standards against National Standards

The Audit team revealed that, WMA took more than two years to verify the secondary standards for their accuracy (traceability). The two years' time exceeded the requirements that set a regular verification to be conducted once in every two years. Untimely, verification of secondary standards in the respective financial years was caused by the delayed calibration service conducted by the TBS. Because of the delayed verification of secondary standards at WMA HQ, WMA regional offices continued verification activities with unverified secondary standards.

WMA did not Conduct Adequate Verification for Accuracy (Traceability) of Working Standards

WMA did not verify all the mass working standards. During the Audit WMA could not provide evidence of some of WMA regions to show that they verified their mass working standards. For example, Pwani and Mtwara did

not verify its mass working standards for 1 financial year which is in 2018/19. The best performance was with Tabora, Temeke, Dodoma, Kinondoni, Mwanza, Kilimanjaro, Ilala, and Tanga which managed to verify their mass working standards throughout the entire Audit period.

The Audit team further noted that, volume working standards such as proving tanks and glass measuring cylinders were not adequately verified. For example: Kinondoni did not verify for 3 financial years. Ilala, Temeke, Tanga, Mwanza and Pwani WMA regions did not verify proving tanks in 2 financial years, while Tabora, Dodoma, Kilimanjaro and Mtwara regions did not verify their proving tanks for 1 financial year. Non-verification of volume working standards such as proving tanks and measuring cylinders was caused by short supply of such working standards in all regions, as a result different WMA regions had to share these instruments. The management of those instruments by sharing was not adequate to the extent that verification exercise was not effective. This may have resulted to unfair transaction to traders, customers, and manufacturers.

The Audit team noted that, the length measuring working standards in all visited WMA regions were not verified for accuracy (traceability). This implies that standard meter rules in the visited WMA regions were not verified for accuracy before they were used. Because of that the unverified length measuring instruments which were tape measures, gave doubted measurements as a result, and may have led to unfair transactions.

Inadequate Approval of the Pattern for Measuring Instruments

The Audit team noted that, WMA managed to give patterns approval on 7 out of 39 Measuring Instruments which was equivalent to 18%. The patterns of the remaining 82% of the categories of measuring instruments were not approved. This was contributed by lack of detailed analysis by WMA to assess the national picture of presence and the types of measuring instruments

which were used in the country. Because of that, there has been a risk that measuring instruments like fuel dispensers, flow meters, water meters entered in the markets without approval of its pattern and could be operating illegally. This can be subjected to seizure or facing other legal actions. If this happens, it can create loss to the traders, suppliers or manufacturers or the users of those measuring instruments. Meanwhile, operating with measuring instruments which were not pattern approved could also lead into unfair transactions and tax collection because these instruments may not be able to maintain accuracy at different environmental and operating conditions.

Inadequate Re-Verification of Measuring Instruments by WMA

The Audit team noted that, WMA conducted re-verification of measuring instruments according to set targets and there were instances the performance exceeded the set targets. However, the Audit team was not able to assess the performance of initial verification and re-verification of measuring instruments separately. This is because WMA in their reporting system did not separate the reporting of these two functions. For example, it was difficult to assess the verification performance of water meters in all WMA regions visited. This is because, the existing database for number of water meters presented in each region did not indicate whether the meters had undergone initial verification or re-verification. It only indicated what was verified. Therefore, the performance rated to WMA was not realistic, because of the distracted performance data.

Inadequate Monitoring of Calibration of Volume and Flow Measurement Conducted by Private Practitioners

The Audit team noted that, WMA did not adequately monitor calibration of volume and flow measurement, this was caused by lack of established information management system to allow WMA to update the status of

private practitioners on regular basis. In addition, WMA did not have any reports to show its performance in managing private practitioners, such as a report to show the number of private firms in which WMA attended them and the rate of compliance and rejection. The only noted control put by WMA was a requirement that all private practitioners have to renew their licences once every year. Apart from that, the private practitioners were not adequately monitored, this limited the assurance of calibration and ultimately may result to false measurements.

Potential Loss Approximates Ranged from TZS 2.5 to 148 Billion from Inspection Fees of Unattended Manufacturers Factories

The Audit team noted that, WMA did not inspect majority of manufacturing industries. It inspected only 2.8% of the manufacturing industries in ten regions covered in this Audit team. Based on responses from WMA on this, WMA had limited human resources to cover all manufacturing industries each year. However, the Audit team noted further that, WMA did not have even a database of all manufacturing factories in their areas, to at least plan and strategize how they can strategically conduct inspection to all. Since there were inspection fees for each inspected factory, the Audit team noted that, WMA lost a potential revenue in form of inspection fees to the unattended industries. For example, the calculated potential revenue loss was estimated to range from approximately TZS 2.5 to 148 billion per year for the small and large factories respectively. This is what was lost for not inspecting manufacturing industries in the calendar year 2020.

Lack of Strong Surveillance and Reporting System by WMA

The Audit team noted that, there was inadequate surveillance and reporting system. The current reporting system was paper based both from regions and surveillance section to the technical management. The manual submission of the surveillance reports affected WMA to make timely

decisions because of some of these reports were delayed or lost on the way. Lack of a web based reporting system reflected less priority given in the budget, as a result takes long time for the surveillance data to be collected, prepared, and dispatched.

TBS did not Adequately Manage to Assume the Custodian Role of the National Metrology Institute (NMI)

TBS did not adequately assume this role of doing the functions of the National Metrology Institute as required by the Tanzania Bureau of Standards Act, 2009. The Audit team observed that key metrological activities in areas of legal, scientific, and industrial metrology were not implemented at TBS as NMI. Some of these activities were delegated to a small section at TBS and the Metrology laboratory Section. Given the small capacity of the Metrology laboratory Section and lack of the regulations those activities were not efficiently done.

Inadequate Capacity in Terms of Reference Standards/National Measurements at TBS

The Audit team noted that, TBS as National Metrology Institute did not establish eight National measurement standards. As result, there were inadequate references or benchmarks. Because of that, there were inadequate calibration laboratories for tracing measuring equipment to ascertain their reliability. The review of documents also showed that TBS did not have key reference standards in some of key areas such as radiology; sound; lights; viscosity; high voltage; flow rates; frequency in aviation and air quality. The cause of this observed deficiency was connected to conflicting priorities on given resources and the complication of tendering of reference equipment in which bidders did not respond to the tender process due to Government's procurement process which normally required

payment to be affected after delivery. As a result, TBS was unable to verify all WMA standards due to limited capacity in terms of reference standards.

Inadequate Inter-Laboratories Comparisons in All Aspects of the Metrological Instruments by TBS

The Audit team noted that, in all financial years covered in this Audit, TBS did not adequately conduct inter-laboratories comparisons in all aspect of metrological instruments. Inter-laboratory comparison was not made because TBS did not have reference standards in some of the field areas like pressure, electrical, chemical, force, torque, and density. Due to lack of these reference standards, TBS laboratory was not accredited by the responsible international standards. As a result, TBS could not adequately demonstrate their capabilities in term of reference standards and maintain quality of laboratory performance.

Inadequate Implementation of Scientific and Industrial Metrological Control Activities by TBS

TBS through Metrology Laboratory did not manage to implement all set annual targets for calibration of instruments throughout the entire audit period. Although the average performance to the targets was above 80% for the industrial metrology, inadequate number of working standards for calibration was a key reason for the gap. Having little number of working standards for calibration, it has been difficult for technical personnel to divide into different groups for conducting calibration services to different customers. In addition, based on interviews with TBS officials the scientific metrology was not conducted, and TBS has been relying on the scientific researches done by other Higher Learning Institutes and other research institutions to get the picture and information related to state of scientific metrology. However, TBS did not conduct researches on metrological subject even though, this institute has its own research department. It was

later known that, these deficiencies were connected to lack of planning and commitment by TBS in conducting scientific metrology. There was no known established financing mechanism for these activities.

Inadequate Performance Monitoring of Executive Agencies under the Ministry

Review of the monitoring reports noted that, monitoring approach applied by the Ministry of Investment, Industry and Trade (MIT) to its agencies was found not effective. This because, based on the Annual Performance of 2020/2021. The Audit team noted that, the MIT did not monitor its agencies based on established Key Performance Indicators (KPI) or targets. Instead, the MIT just received the quarterly reports from its agencies (WMA and TBS) and consolidated them. There were no reports to show that the ministry conducted evaluation to assess the performance of WMA and TBS.

Moreover, it was noted that, the MIT did not verify the submitted information as part of its validation process. Based on the interviews with responsible officials, this weakness was partly caused by lack of established monitoring system and support tools which allowed assessment on metrology in the country. The MIT's budget constraints to large extent affected monitoring and evaluation activities. The MIT's budget allocated annually to carry out monitoring activities in the monitoring and evaluation unit was not provided accordingly. There was unreliable disbursement of other charges (OC) and other charges deficit to the MIT, in all years covered by this Audit team the disbursement varied from 30% to 45%. There was no any year of the Audit team scope the budget exceeded 45%. It is because of this, the monitoring and evaluation activities suffered low priority in ranking.

Audit Conclusion

The Audit findings lead to the conclusion that the Ministry of Investments, Industry and Trade (MIT), the Weights and Measures Agency (WMA) and Tanzania Bureau of Standards (TBS) inadequately implemented control activities on legal, scientific and industrial metrology. This is because both WMA and TBS did not adequately verify accuracy of both standards and measuring instruments. In addition, the MIT did not adequately monitor the activities implemented WMA and TBS to protect consumers on issues related to measurements.

Audit Recommendations to Weights and Measures Agency
Weights and Measures Agency should:

1. Establish comprehensive database to capture all legal control activities for both standards' performance status and patterns approval;

2. Establish comprehensive resource needs analysis to establish gap of both secondary and working standard equipment, human resources, vehicles, and tools needed for effective implementation of legal metrological activities;

3. Develop office policies for supporting effective enforcement of measurement standards and develop guidelines based on European Union (EU) directives and OIML recommendations other than volume and flow measures to assist staff in planning, conducting, and reporting their operations;

4. Prioritize capacity building of the institution in terms of all required secondary and working standards, keeping standards in their acceptable ambient conditions of traceability of its accuracy,

training programs and human resources including conducting cost and benefit analysis of temporary and permanent employees so as to enhance competence of WMA on emerging issues of metrology; and

5. Prioritise risk-based and realistic targets based on reliable source in planning and implementation of existing legal and metrological measuring instruments including public and consumers' awareness so as to achieve effective consumers' protection.

Recommendations to Tanzania Bureau of Standards

Tanzania Bureau of Standards should:

1. Establish comprehensive database to capture all reference standard equipment, performance status, scientific and industrial control activities;

2. Conduct a comprehensive needs analysis to establish gaps of both reference standard equipment and human resources needed for effective implementation of country's needs; and

3. Prioritize capacity building in terms of all required reference standards, trainings and human resources to increase competence of TBS for effective performance of metrological activities as the National Metrology Institute.

Recommendations to the Ministry of Investment, Industry and Trade

The Ministry of Investment Industry and Trade should:

1. Prioritize completion of National Quality Policy including establishing national accreditation body that will support accreditation of calibration and testing laboratories in the country so as to improve the quality of infrastructures of metrology in the country;

2. Develop a monitoring system and support tools such as guiding document to oversee implementation and assessment of legal, scientific, and industrial metrology in the country; and

3. Consider establishment of an independent department that would implement the functions of the National Metrology Institute in the country to enable independent supervision and monitoring of legal, scientific, and industrial metrology activities.

CHAPTER ONE

INTRODUCTION

1.1 Background of the Audit

A proper application of Weights and Measures practices is critical in order to ensure that, there is clarity and certainty about measures used. It ensures that producers, traders and consumers are protected, and the Government collects revenues entitled to it.

In recent years, rational decisions making in management practices were highly supported by accuracy measurement readings from digitalized measuring instruments. All important decisions depended on measurement be it on diagnosis and therapy, in trade, in environmental protection, most of these decisions are largely made on the strength of measurements done by non-metrologists.

There have been protests from the producers and consumers concerning errors of the weight and measure due to the misbehaviors of measurement equipment. This in one way is because of weak enforcement of the regulations governing compliance to standard weights and measures. Such differences created a demand for ensuring that consumers, businesses, and manufacturers are protected from unfair practices through the application of accurate weights and measures.

1.2 Motivation of the Audit

This Audit was motivated by the following factors:

a) Existing complaints from the producers and consumers concerning errors of the weight and measure due to the misbehaviours of

measurement equipment which led people to distrust the way their products are measured.

For example, the peasants from Magu, Mwanza registered their claims about misbehaviour of weighing scale and improper measurement of their crops and the way operators temper with measuring scales to mislead actual weight[3];

b) Existence of weak enforcement of the regulations governing compliance to standard weights and measures in Njombe Region, Tanzania [4]

A standard weight for potatoes is a single package that does not exceed 100kg (ECi Africa & DAI-PESA, 2004). Traders opt to over package their produce in large bags famous known in Kiswahili as "*lumbesa*" in order to maximize profit on expense of averting the Crop Cess Levy paid to the Local Government Authority. Transport costs which are both charged per bag with an assumption that each bag has a standard weight of 100kg;

c) According to (Shunashu and Pastory, 2020), lack of accuracy on measurement in the transferred energy involves significant financial risk to the buyer, seller, and the Government taxation; and

d) According to Shunashu and Pastory, 2020, less than 30% metrological control in the energy sector has been implemented such as the verification of electrical meter, natural gas meters and petroleum meters. This might deny the fair trade, restrain transparency in energy transaction and hinder the removal of barriers to trade especially in the natural gas[5].

[3]TBC news reported 07th July, 2019 (https://www.youtube.com/watch?v=0wolL7Xu4WE&t=17s)

[4]Report of the Kenneth M. K. Bengesi "The Factors Hindering Use of Standard Weights and Measures along Irish Potato Supply Chain" 2018

[5] Improved Metrology Infrastructures for the Development of Energy Industry in Tanzania.

1.3 Audit Design

This part explains about the main Audit objective, specific Audit objective, scope of the Audit, methods for data collection and analysis, and assessment criteria.

1.3.1 Audit Objective

The Audit objective was to determine whether the Weights and Measures Agency (WMA) and Tanzania Bureau of Standards (TBS) adequately implemented control activities on legal, scientific, and industrial metrology to protect consumers on issues related to measurements and whether the MIT effectively monitored the implementation of such activities.

Specifically, Audit focussed on assessing whether: -

(a) WMA efficiently managed verification for accuracy (traceability) of secondary and working standards;

(b) WMA adequately conducted pattern approval of measuring instruments;

(c) WMA ensured verification for accuracy of measuring instruments;

(d) WMA adequately managed pre-package of goods;

(e) WMA through surveillance and inspection ensured that the control set for compliance with metrology performs well;

(f) TBS adequately acted as National Metrology Institute (NMI) and conducted control activities on scientific and industrial metrology; and

(g) MIT effectively monitored legal, scientific, and industrial metrological activities performed by WMA and TBS.

The Audit and sub audit questions for addressing audit objectives are presented in ***Appendix* 2**.

1.3.2 Audit Scope

The Ministry of Investment, Industry and Trade (MIT), the Weights and Measures Agency (WMA) and Tanzania Bureau of Standards (TBS) were the main audited entities. The Audit focused on assessing Management of standards and verification for their accuracy (traceability) of secondary and working standards; Pattern approval of measuring instruments; Verification for accuracy of measuring instruments. In addition, Surveillance of legal metrological activities and available capacity with TBS to conduct metrology activities; and conduction of scientific and industrial metrological activities to ensure maintained national measurement standard, promoted traceability of standards and conformity assessment.

The data and information were collected from the following areas: Coastal Zone, Northern Zone, Lake Zone, Central Zone, zones having ports (Northern and Southern) and Western Zone are zones which were visited; in every selected zone, one region was visited.

1.4 Sampling, Methods for Data Collection and Analysis

1.4.1 Sampling Techniques Used

The Audit team selected, purposively, eight regions for data collection visit. The selected regions irrespective of geographical zones are Dar-es-salaam, Pwani Region, Tabora, Mwanza, Dodoma, Kilimanjaro, Tanga and Mtwara. Dar es Salaam, Tanga and Mtwara were selected because there was presence of ports whereby measurements for flow of edible oil and petroleum fuel (oil and gas) are taken by WMA during petroleum and edible oil products importation by vessels. Pwani Region was given priority because it was the only region in Tanzania having electrical calibration machines, heavy-duty water meter calibration machines and east Africa vehicle tanks calibration. Kilimanjaro, Tabora, Mwanza, Dodoma were Regions representing zones in which there are no ports. For TBS, TBS HQ was covered because metrological activities were performed by Metrology Section, which was located at TBS, Dar es Salaam.

The Audit covered four financial years 2017/2018 to 2020/21. The selected period enabled Auditors to establish trend of executed metrology activities and develop reliable conclusions relating to the findings.

1.4.2 Methods Used for Data Collection

The Audit team gathered information to address the Audit objective and questions. The Audit evidence was triangulated with different sources of information. Data were gathered from MIT, TBS, WMA HQ, and selected WMA regional offices. Both qualitative and quantitative data were collected and analysed to provide evidence regarding management of standards and verification for accuracy of measuring instruments. Moreover, management of pre-packed goods, surveillance of legal metrological activities, available capacity with WMA and TBS to conduct metrology activities; and conduction

of scientific and industrial metrological activities to ensure customers protection.

Three different methods were used to collect the data which were interviews, review of documents and physical observations.

(a) Documents Review

The Audit team reviewed documents from MIT, WMA, TBS and respective WMA regional offices in which legal, scientific and industrial metrology activities were implemented so as to identify the risks and or impacts and possible causes for observed situation and thereafter be able to gather evidence and come up with clear findings and recommendations. The team wanted to seek evidence of the information that was obtained through interviews and site visit.

Reviewed documents were for the financial years starting from 2017/18 to 2020/21 and included: Plans and budgets, performance reports, correspondences, and Monitoring and Evaluation reports. The list of documents reviewed is summarized in ***Appendix 3***.

(b) Interviews

This method was used to seek information and clarification from different level of officials responsible for metrological activities at the MIT, directors, and managers of sections responsible with metrological activities at WMA and TBS HQs and Regional Managers of sampled WMA regions for visit. The list of persons interviewed is summarized in ***Appendix 4***.

The interviews were guided by audit questions depending on the audit objective and the responsibilities of the officials interviewed. Refer ***Appendix 2***.

(c) Physical Observations

The Audit Team visited TBS and WMA regional offices where legal metrological activities were implemented to observe the extent to which regional supervision helped to achieve specified quality and Value for Money in general.

1.4.3 Methods for Data Analysis

In this audit various methods were employed in analysing data depending on the nature of data and available evidence.

Quantitative data were organised, summarized, and compiled using software for data analysis such as excel spread sheets. The analysed data were presented by different ways such as tables, graphs, and percentages distribution.

Qualitative data were described, compared, and related so that they can be extracted and explained in order for the data to be contended, defended and extended to bring into findings that are aligned to the audit objectives. The analysis involved looking for categories such as events, descriptions, looking for consistencies or differences to develop theory from the gathered data.

1.5 Assessment Criteria

The Audit criteria for audit questions and sub questions were based on the roles played by MIT, TBS, WMA and requirements of laws and regulations pertaining to legal metrology. These were Approved Functions and Organization Structure of WMA of 2018; the Weights and Measures Act (CAP 340 of 1982); The Weights and Measures (General) Regulations, 2019; the Weights and Measures (Metrological Control of Water meters) Regulations,

2014; the Weights and Measures (Sand and Other Ballast) Regulations, 2013; the Weights and Measures (Fixed Storage Tank) (Amendment) Regulations, 2007; the Weights and Measures Act (Amendment) Order, 2018; and management guideline. The criteria used are as shown hereunder:

Management of Standards and their Traceability

According to Part 3.1.1 (iii)] of Functions and Organization Structure of the Weights and Measures, 2018 WMA is required to keep records of standards and their performances.

Section 7 (2) (a) of Weights and Measures Act of 1982 requires periodic verification of Secondary Standards to be conducted once in every two years. The act further requires Secondary Standards to be compared with the National Standards and if necessary be corrected and adjusted by the Tanzania Bureau of Standards or any other competent institution.

Furthermore, according to, Section 7 (a) and (b) of Weights and Measures Act of 1982 require Secondary Standard to be compared with the National Standards once in every two years and if necessary be corrected and adjusted by the Tanzania Bureau of Standards or any other competent institution as the Minister may direct; and certificates of correctness be issued;

According to Section 10 (2) of Weights and Measures Act of 1982 requires working standards to be compared with the Secondary Standards once at least in every twelve months and, if necessary be corrected and adjusted; and

According to Part 3.1.1(v) of Functions and Organization Structure of the Weights and Measures of 2018 WMA is required to approve new patterns, review old ones, and keep their records.

Furthermore, according to Section 18 (2) (a) of Weights and Measures Act of 1982 requires that weight, measure, weighing or measuring instruments to be pattern approved by the Minister before they are used for trade.

Pattern Approval of Measuring Instruments

According to Section 18 (2) (a) of Weights and Measures Act Cap 340 requires that weight, measure, weighing or measuring instruments to be pattern approved by the Minister before they are used for trade.

Verification for Accuracy of Measuring Instruments

According to Section 19 (1) and (2) of Weights and Weights and Measures Act of 1982 Cap 340 requires that not more than once in every twelve months, in respect of an area of jurisdiction, an assizes[6] to notify and require all persons who have in their possession any weight, measure, weighing or measuring instrument which is used or intended to be used in trade, to produce at such time and place to be examined and verified;

According to Part 3.1.3 (i) of Functions and Organization Structure of the Weights and Measures of 2018, WMA is required to approve technical drawings and structure of volume and flow measures;

Moreover, according to Part 3.1.3 (v) of Functions and Organization Structure of the Weights and Measures of 2018, WMA is required to conduct metrological supervision of imported gas, oils and fuels; and

Furthermore, according to Part 3.1.3 (vii) of Functions and Organization Structure of the Weights and Measures of 2018, WMA is required to monitor the verification of utility meters.

[6] Inspector

Management of Pre-Packaged Goods

According to Reg. 182(1) of the General Regulation of Weights and Measures of 2019 points out that; a pre-packed product shall bear a declaration of the net quantity of the product on the principal panel;

According to the National Institute Standard of Technology (NIST) handbook 133 of 2013, revealed that, there were three levels of checking the net contents of the packaged goods such as at point-of-pack, at wholesale and at retail;

According to Reg. 175 (1), PART XXII of the General regulation of the WMA, 2019 revealed that, goods produced, manufactured or packed locally or otherwise shall be subject to inspections, testing and certification by the inspector at least once in every year;

According to Part 3.1.2 (i) of Functions and Organization Structure of the Weights and Measures of 2018, WMA is required to monitor performance of metrological inspections of pre-packed goods and measuring instruments and systems.

According to the Section 2(1) of the Weights and Measures Act (Amendment) Order, 2018; the packaging of farm produce shall be in weight, number, volume, or length. However, Section 2(2) (b) amplified for the purpose of sub paragraph (1) that, farm produce packed in- weight shall not exceed the weight of 100kg, with tolerance of +5.

Management of Surveillance Activities

According to Part 3.1.2 (IV) of Functions and Organization Structure of the Weights and Measures of 2018, WMA is required to maintain and update records of all verified measuring instruments and systems.

According to Part 3.1.2(v) of Functions and Organization Structure of the Weights and Measures of 2018, WMA is required to prepare reports by scrutinizing, analysing and compiling reports from regional office for advice.

According to Part 3.1.2(vii) of Functions and Organization Structure of the Weights and Measures, 2018 requires WMA to devise ways and methods of raising public awareness on legal metrology activities.

Implementation of TBS as NMI and Undertaking of Scientific and Industrial Metrological Activities

A National Metrology Institute, consisting of one or more standards laboratories, which can also be part of for instance a university or other scientific institute[7];

Furthermore, Section 4.-(1)(l) of the Standards Act, 2009, TBS was required to act as the custodian of the National Measurement Standards of weights and measures and from time to time adjust, replace, or cancel any standards where the adjustment, replacement or cancellation is necessary for the maintenance of conformity to the international standards.

According to Section 4 (1) (l) of the Standards Act, 2008 states that, the function of TBS among others is to act as the custodian of the National Measurement Standards of weights and measures.

As a normal practice the national measurement standard is the place where the country's different measurements rely on to find international

[7]Page 21 of Chapter IV, paragraph 2 of the OIML (International Organization of Legal Metrology) D 1, Edition 2004 (E)

reference standard equipment for testing and calibration laboratories for tracing its measuring equipment so as to deliver reliable results.

According to TBS's functions through Metrology Laboratory Section, TBS is required to maintain and develop national measurement standards.

According to TBS's functions through Metrology Laboratory Section, TBS is required to provide traceability to the national measurement system.

TBS having Adequate Capacity in Terms of National Measurement Standards

According to TBS's functions through Metrology Laboratory Section, TBS is required to act as custodian of National Measurement Standards.

As a normal practice in performance of a system, in order to achieve the expected outputs, it will much depend on the resources input in that system including humans. TBS required having human resources enabling to conduct scientific and industrial metrological activities.

Monitoring and Evaluation of Legal, Scientific, and Industrial Metrology Performed by WMA and TBS

According to Part 3.6.2 (i), (ii), (x) of Functions and Organization Structure of the Ministry of Trade and Industry, 2019; the Ministry was required to monitor and evaluate implementation of its Annual Plans and Medium Term Strategic Plans; prepare periodic performance reports; and monitor performance of Executive Agencies under the Ministry.

As a normal practice the role of responsible Ministry was overseeing the implementation of the respective institutions. MIT was required to apply

results of Monitoring and Evaluation to make improvement on legal, scientific and industrial metrology.

1.6 Data Validation Process

The MIT, TBS and WMA and were given the opportunity to go through the draft report and comment on the figures and presented information. They all confirmed on the accuracy of the figures used and information presented in the report. The information was also cross-checked and discussed with experts in area of legal, scientific, and industrial metrology to ensure its validity.

1.7 Standards Used for the Audit

The Audit was conducted in accordance with the International Standards of Supreme Audit Institutions (ISSAIs) issued by the International Organization of Supreme Audit Institutions (INTOSAI). Those standards require that the Audit be planned and performed in order to obtain sufficient and appropriate evidence to provide a reasonable basis for findings and conclusions based on Audit objective.

1.8 Structure of the Report

The remaining part of the report covers the following:

CHAPTER TWO

SYSTEM FOR IMPLEMENTATION OF CONTROL ACTIVITIES ON LEGAL, SCIENTIFIC, AND INDUSTRIAL METROLOGY

2.1 Introduction

This chapter provides information regarding legal framework, key actors, and existing system for implementation of control activities of legal, scientific and industrial measurements.

2.2 Metrological Policy and Legal Framework

Currently, Trade and Agriculture Marketing policy govern legal, scientific, and industrial metrology in Tanzania. However, during Audit, the National Quality Policy was under review. They were also governed by the Weights and Measures Act (CAP 340), of 1982 and the Weights and Measures (General) Regulations, 2019.

2.3 Role and Responsibility of Key Stakeholders Involved in Implementation of Control Activities in Metrology

Key Actors

These are actors directly involved in implementation of control activities on legal, scientific, and industrial metrology are as described below:

The Weights and Measures Agency (WMA)

The Weights and Measures Agency (WMA) is an Executive Agency, responsible for fair trade transactions through certification of weights and measures. It is the sole agency in Tanzania Mainland for enforcing the Weights and Measures Act No.20 of 1982. WMA is solely dedicated to protecting consumers, businesses and manufacturers from unfair practices through the application of accurate weights and measures. It endeavours to ensure optimum use of resources and fair trade interactions between investors, producers, transporters and consumers with an emphasis on consumer protection. The Agency is performing its duties through various Sections.

Tanzania Bureau of Standards (TBS)

Tanzania Bureau of Standards is among important Weights and Measures stakeholders when it comes to issues of traceability of various standards to the national standards. TBS is a custodian of National Measurement Standards in the country. It is responsible with providing traceability to the National Measurement System. It also ensures quality of petroleum products by laboratory measurement before they have been allowed to be discharged in the country.

The Ministry of Investment, Industry and Trade (MIT)

The Ministry of Investment, Industry and Trade is responsible with budget allocation, funds disbursement and Monitoring and evaluation of control activities implemented by WMA and TBS.

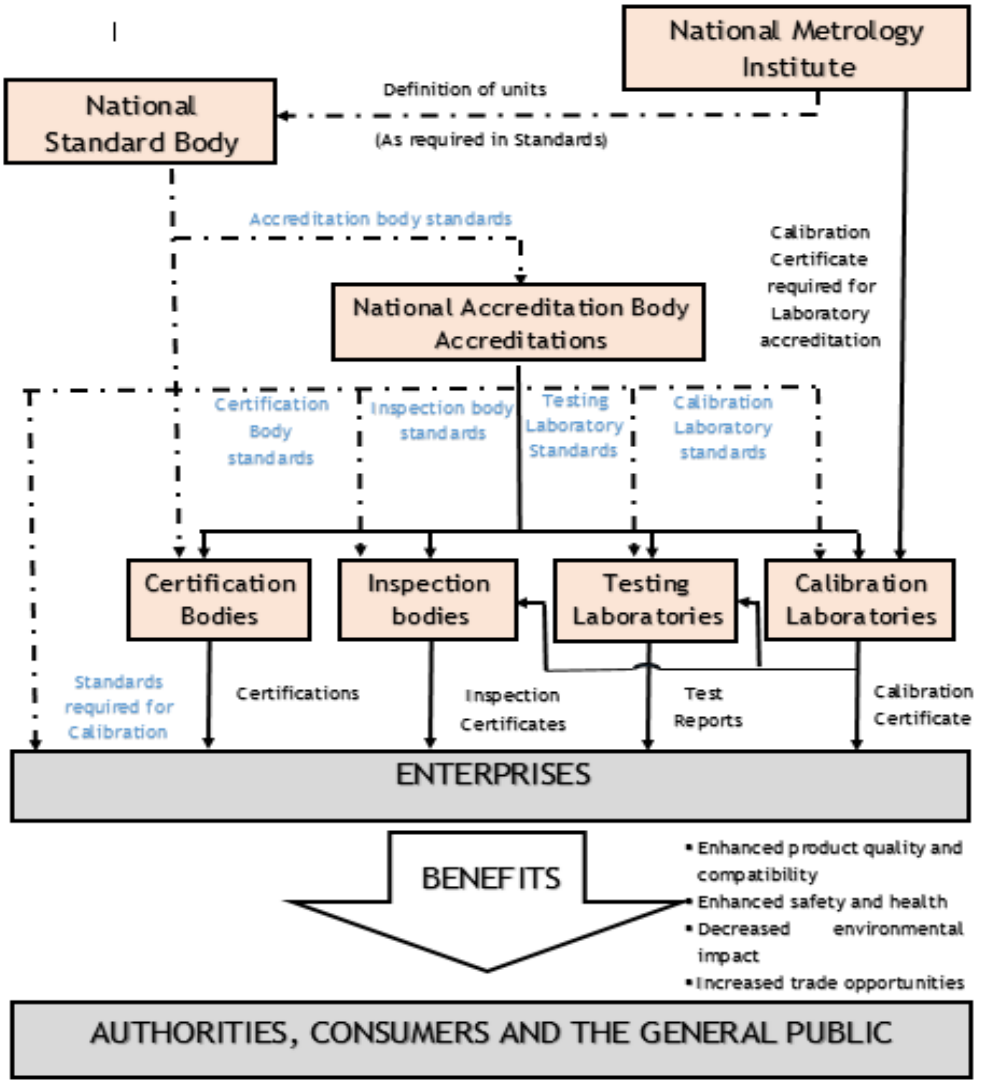
2.4 Metrology Control Processes

The process for implementing control activities on legal, scientific and industrial metrology varies from one to another.

Quality infrastructure in any country refers to all aspects of standardization, metrology, testing, conformity assessment and quality management including accreditation and certification. This includes both public and private institutions and the regulatory framework within which they operate. In Tanzania, the National Legal Metrology Institute (NLMI) represented by WMA and the National Metrology Institute (NMI) represented by the Tanzania Bureau of Standards (TBS) were two public institutions that take responsibility to underpin the major functions of quality ranging from metrology and standardization. In order to sustain the improved quality in production, manufacturing and services, most countries have established their national quality infrastructure following the framework recommended by the World Bank. [8] **Figure 2.1** presents the framework which Word Bank and other many countries use.

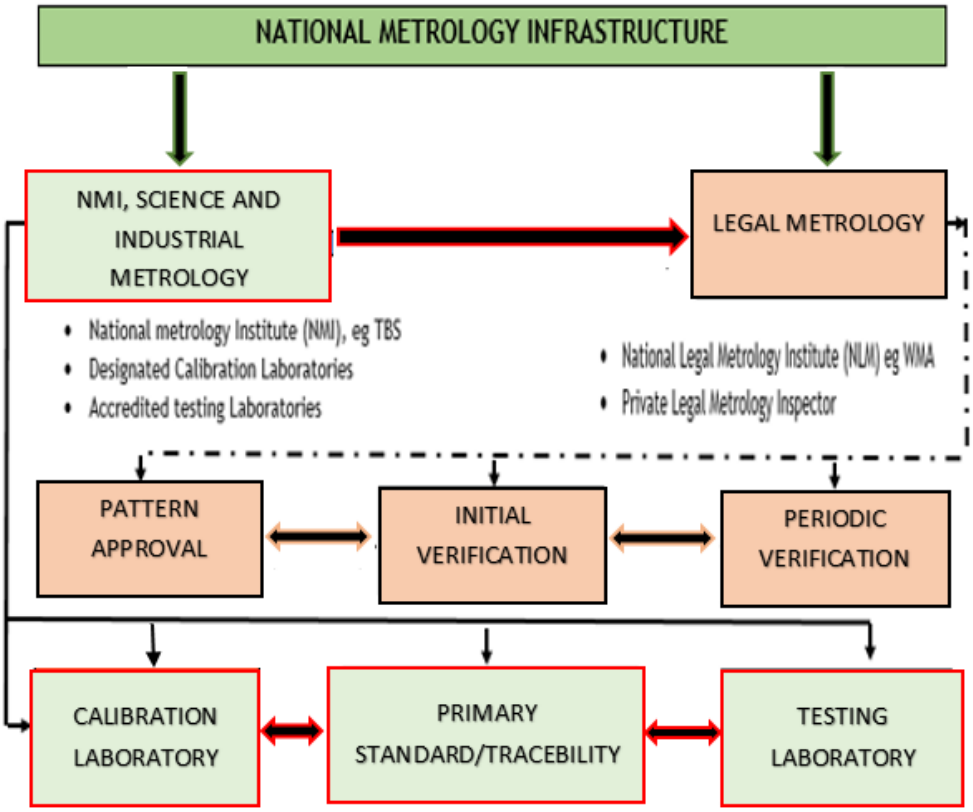
[8]Ishigita Lucas Shunashu and Dr. Dickson Pastory (PhD) (2020), Paper Title: Improved Metrology Infrastructures for the Development of Energy Industry in Tanzania

Figure 2.1: National Quality Infrastructure Established by many Countries



Source: *Word Bank Report of the National Quality Infrastructure, 2007*

Figure 2.2: Current National Quality Infrastructure in Tanzania



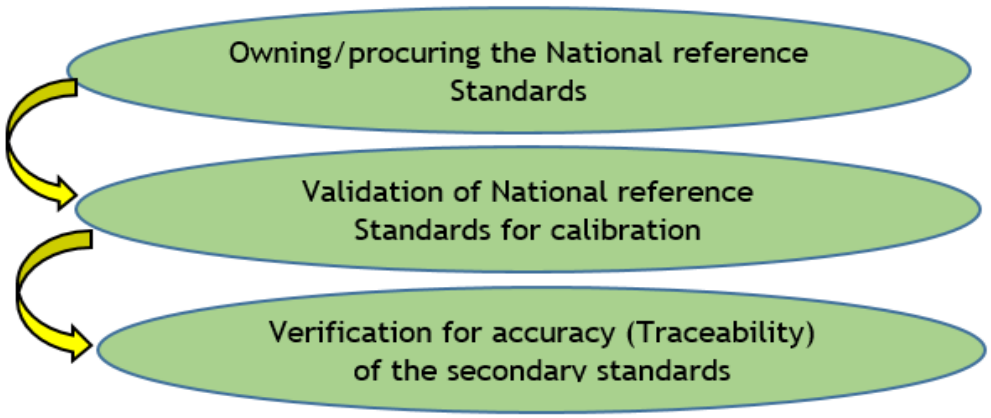
Source: *Auditors' Analysis Based on Review of the Documents and Interviews*

Metrology process control in Tanzania as referred from **figure 2.2**, the National Metrology Institute (NMI) performed by the TBS as custodian and legal metrology performed by WMA and scientific and Industrial metrology performed by Metrology laboratory section at TBS are detailed in Sections 2.4.1 and 2.4.2 respectively.

2.4.1 The Process of the Metrology Activities Performed by the TBS as National Metrology Institute

The stages performed by the Tanzania Bureau of Standards on conducting its metrological activities as the National Metrology Institute detailed in the **Figure 2.3** below.

Figure 2.3: Stages Performed by the TBS as National Metrology Institute



Source: *Auditors' Analysis Based on Interviews with TBS Staff*

Descriptions of each stage shown in **Figure 2.3** are provided hereunder;

After procurement of national standards, they were validated to assess its accuracy with other standards. The validation process of standards involves the following activities:

(i) Inter - Laboratory Comparison
(ii) Intra - Laboratory Comparison

Inter - Laboratory Comparison (ILC)

According to ISO/IEC 17043:2010, Inter-Laboratory Comparison (ILC) is the organization, performance and evaluation of measurements or tests on the same or similar items by two or more laboratories or inspection bodies in accordance with predetermined conditions.

It served the purpose of validating the capability of your laboratory to provide accurate and reliable results within permissible levels of uncertainty to your customers and also to ensure that the adopted analytical method is suitable for the intended purpose.

Intra - Laboratory Comparison

An Intra Laboratory Comparison is conducted when several analysts or technicians within an organization perform testing or calibrations on the same or similar artefact, using the same method and under specified, controlled conditions.

Verification for Accuracy (Traceability) of the Secondary Standards

At this stage through the National Measurement Standards available at TBS, TBS as NMI, conducted traceability of the secondary standards, owned by the WMA and metrology laboratory section at TBS in order to ensure all accuracies are attained prior those secondary standards to verify working standards of the WMA and metrology laboratory section at TBS. This scenario is undertaken once in every two years.

2.4.2 Control Process on Legal, Science and Industry Metrology

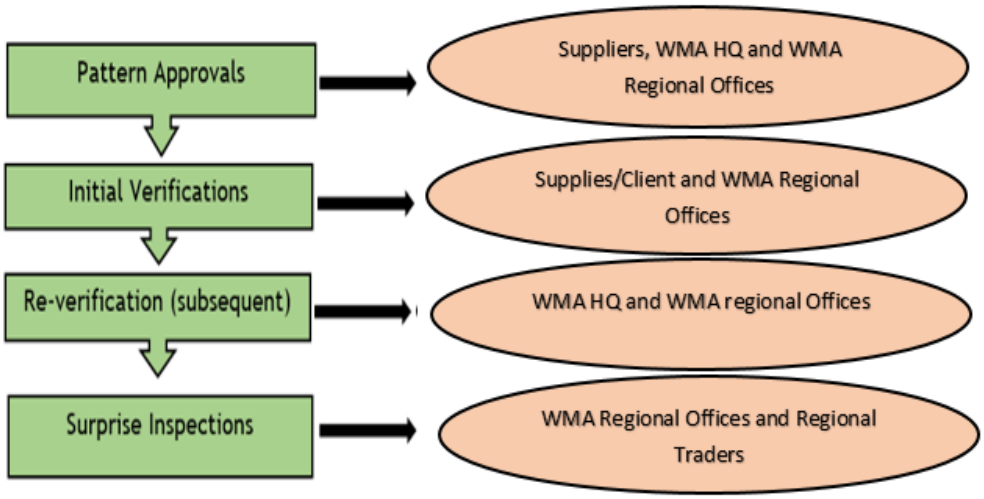
The processes on legal metrology performed by WMA, scientific and Industrial metrology performed by TBS Metrology Laboratory are as detailed hereunder:

Control Process on Legal Metrology

The first process starts by tracing of working standards used by inspectors from WMA regional offices. At this stage working standards traced by using the secondary standards available at WMA Headquarters which were traced by the National standards available at the Tanzania Bureau of Standards. Tracing interval requirement is once at least in every twelve (12) months. After working standards being traced to the secondary standards, they become ready to be used to verify commercial measuring instruments/standards[9]. *Refer **Appendix 6**;* Example of the measuring instruments. At this stage tracing interval requirement, moreover, is Twelve (12) months. Commercial standards are controlled by the four stages as shown in the **Figure 2.4.**

[9] Standards used by traders to weigh and measure goods to the consumers in the field

Figure 2.4: Weights and Measures General Control Stage and Involved Stakeholders



Source: *Auditor's Analysis Based on Review of the Documents & Interviews with WMA Staff*

The description of each stage Highlighted on Figure 2.4 are provided below:

(a) Pattern Approvals

At this stage samples of measuring instruments expected to be brought in the country by the supplier/dealer were brought to the WMA HQ for checking their capability to sustain over a range of environmental and operational conditions before allowing their entrance. The pattern approval is also performed to instruments locally manufactured before are sold or brought to the market.

(b) Initial Verifications

This is the stage whereby all new measuring instruments with pattern approval which are locally manufactured or imported by supplier/dealer. These are brought to the WMA and checked one item after another if they have same properties as ones in the pattern approval certificates and whether their accuracies are within allowable tolerances.

(c) Sub-Sequent Verifications/Re-Verification

Scheduled verification checks whereby measuring instruments which are already in use are re-checked whether their errors are still within allowable tolerances. The interval for rechecking can be 3 months, 1 year, 2 years or 5 years depending on the type of instruments.

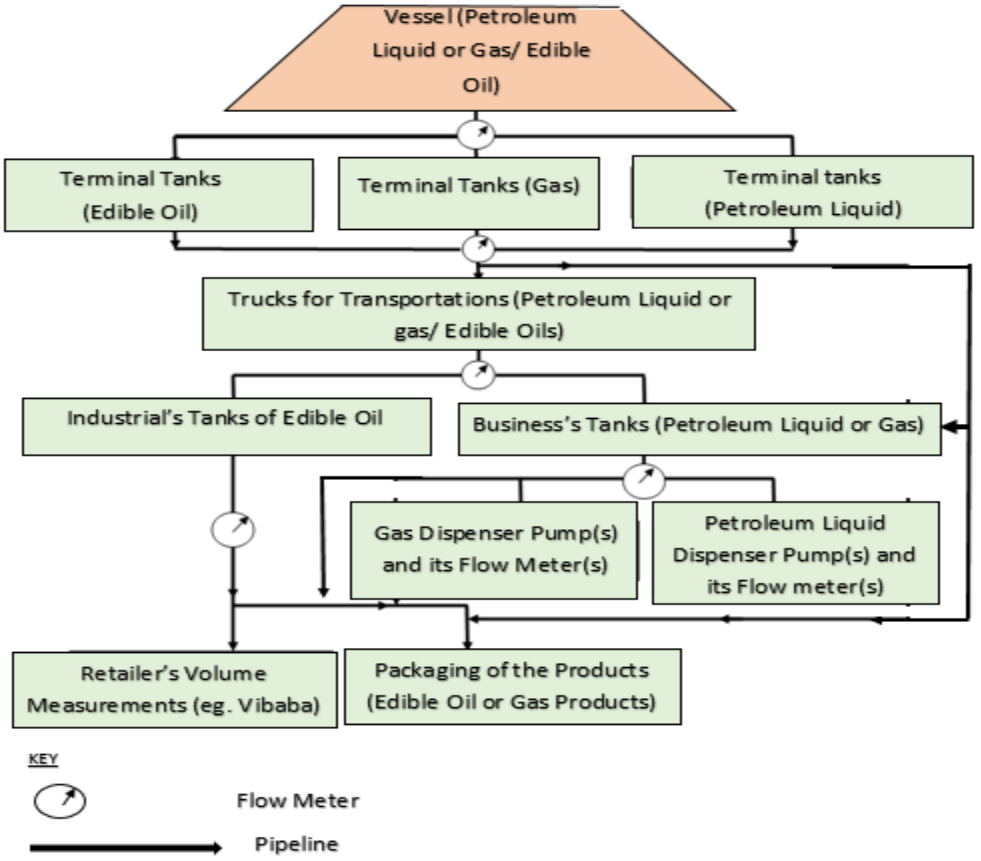
(d) Surprise Inspections

This is verification check which is conducted by surprise to the trader's measuring instruments to re-check their accuracy for the purpose of reducing the possibility of traders tampering with them.

The processes on legal metrology performed by WMA had others specific processes such as process control of receiving and discharging of the petroleum fuel (oil and gas) and the edible oil product chain and system of receiving and discharging petroleum products and edible oil in Tanzania. Description of those specific processes are detailed in (i) and (ii) respectively.

(i) The Process Control of Receiving and Discharging of the Petroleum Fuel (Oil and Gas) and the Edible Oil Product Chain

Figure 2.5: Process for Control of Weights and Measures for the Petroleum Fuel (Oil and Gas) and the Edible Oil Product Chain



***Source**: Auditors' Analysis Based on Site Visit & Stakeholders' Interviews, 2021*

Figure 2.5 presents process for control of weights and measures petroleum fuel (oil and gas) and the edible oil. It was the chain of metrological control

for petroleum fuel (oil and gas) and the edible oil starting from when the vessel tank is ready for discharging to the user or consumer of the product.

The description of each stage highlighted on **Figure 2.5** are provided below:

Point of Measurement at Vessel Tank

This is point of measurement after arrived Ship/Vessel giving notice of readiness. At this point WMA through Port Unit (for case of DSM Port) takes measurements/quantifies the number of imported products. For the case of Tanga and Mtwara ports, Regional Manager in the region with respective Port quantifies the number of imported products. This is done by Ullage Temperature Interface (UTI) gauging method so aforementioned measuring instrument should be verified by WMA.

Point of Measurement at Flow Meter

This is point of measurement between the vessel tank and the depot tank. WMA through Temeke WMA regional office (for case of DSM Port) takes measurements/quantifies the amount of imported products which has been transferred through flow meter. At this point WMA is required verify flow meters.

Point of Measurement at Depot Tanks

This is point of measurement whereby WMA through Port Unit (for case of DSM Port) takes measurements/quantifies the number of imported products which has been received. At this point WMA is required to verify Thermometer, Dipping tape and hydrometer. The measurements are taken three times as: initial, provisional, and final measurements.

Point of Measurement at Vehicle Tanks

This was point of measurement whereby WMA through respective regional offices takes measurements/quantifies the number of transported products. At this point WMA is required to verify flow meters and dipping sticks.

Point of Measurement at Industrial/Business/Underground Tanks

This was point of measurement whereby product traders take measurements/quantify the number of transported products for their own control. WMA was also supposed to calibrate the tanks and dip sticks.

Point of Measurement at Dispensing Pumps

This is point of measurement whereby WMA through respective regional offices conducts verification and re-verification of the dispensing pumps. At this point, WMA is required to verify flow meters

Flow Meters Points of Measurements

In between every two points of measurements from when the vessel is ready to discharge to when the dispensing pump is measuring the product for customers use, there are flow meters. At flow meters WMA is supposed to verify and re-verify the used flow meters.

(ii) System of Receiving and Discharging Petroleum Products and Edible Oil in Tanzania at the Ports.

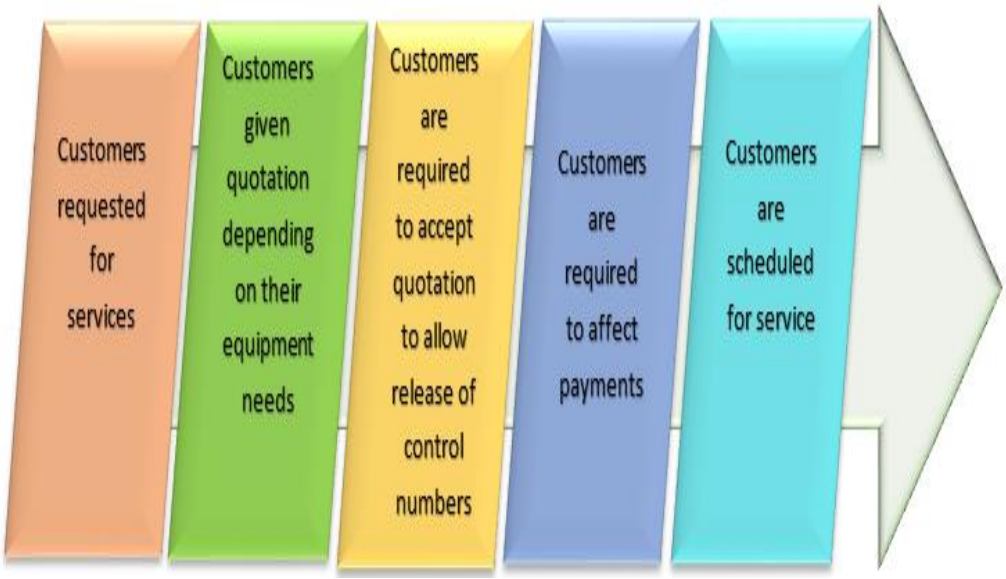
In Tanzania there are several ports areas used for mooring the ships, Kurasini Oil Jet (**KOJ**) and Single Mooring Buoyance (**SBM**) available in Dar es Salaam, Tanga port, Mtwara port and Zanzibar port. KOJ used for mooring all ships bear both petroleum products and vegetable oils, SBM used for

mooring only big ships that bear diesel oil only while Zanzibar, Tanga and Mtwara ports used for mooring ships that bear petroleum liquids (petrol and diesel).

2.4.3 Control Process on Scientific and Industrial Metrology

The first and foremost, process starts by tracing of working standards used by inspectors from TBS at metrology laboratory section. At this stage, working standards traced by using the secondary standards available at TBS at NMI laboratory which were traced by the National standards available at TBS at NMI laboratory. Lastly, working standards used to calibrate customers standards on the area of science and industry metrology. Details of the stages involved during calibration activities undertaken are shown in the **Figure 2.6** below:

Figure 2.6: Stages Involved During Calibration Activities



Source: *Auditors' Analysis Based on Interviews with TBS Staff*

Figure 2.6 presents stages involved customers to request for calibration. After customers complete these stages, TBS required to undertake calibration not more than five days from the day of payment and issues of certificates not more than 14 days after payment.

2.5 Resources for Implementation of Control Activities

Financial and Human resources were allocated to the institutions to manage the implementation of control activities on measurements as detailed in following subsection:

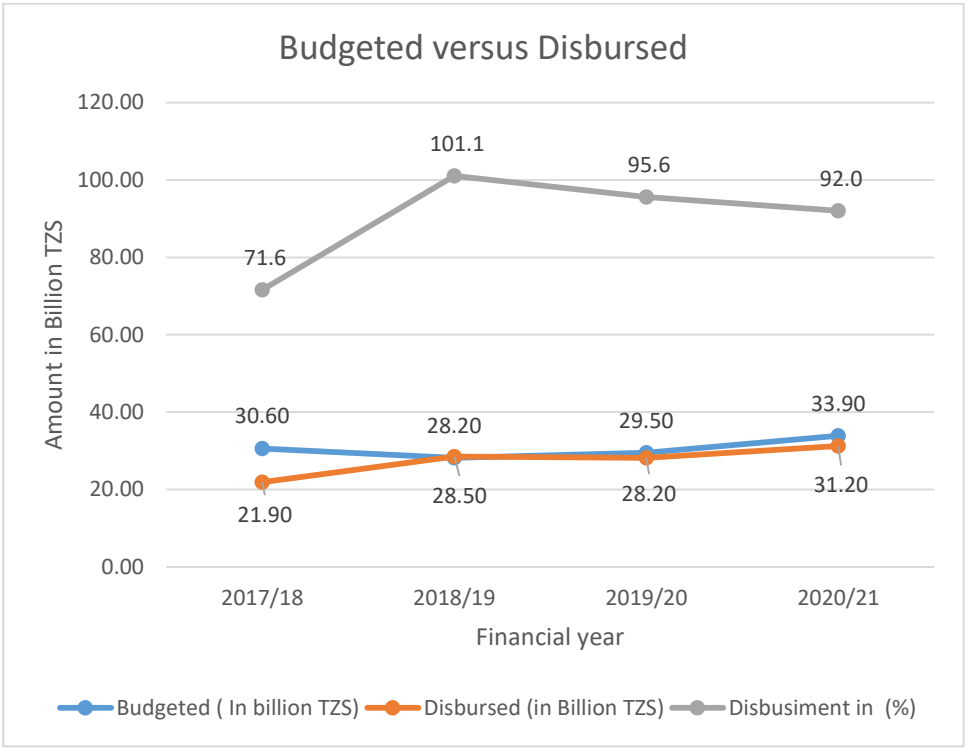
2.5.1 Resources for Implementation of Control Activities at WMA

Financial and Human resources were allocated to the WMA to manage the implementation of legal metrological activities as detailed in following subsection.

Financial Resources

Financial resources allocated to the WMA to manage the implementation of legal metrological activities in the financial year 2017/18 to 2020/21 are as presented in **Figure 2.7.**

Figure 2.7: WMAs' Budget versus Disbursement in the Financial Years 2017/18-2020/21



Source: *WMA Financial Statement 2017/18 to 2020/21*

Figure 2.7 indicates that the amount released for procuring reference standards were less than the budgeted in financial year 2017/18, 2019/20 and 2020/21 except in the financial year 2018/19.

Human Resources

Implementing control activities on metrology requires human resources which were inspectors. The situation of Human resources at both WMA HQ and WMA regions at the time of Audit is presented in **Table 2.1.**

Table 2.1: Inspectors Employment Status as of December 2021

WMA Region	No. of Needed	No. of Permanent	No. of Temporary	% of Temporary
Temeke	26	7	12	63
Kinondoni	17	**6**	**11**	65
Ilala	14	6	8	57
Mtwara	8	3	5	63
Tanga	8	3	5	63
Kilimanjaro	13	5	8	62
Mwanza	10	4	5	56
Tabora	10	6	3	33
Pwani	29	6	20	77
Dodoma	11	4	5	56
Total	**146**	**50**	**82**	**62**

***Source**: Auditors' Analysis Based on WMA HQ Employment Staffing Level, 2021*

Table 2.1 indicates that, Total of 146 staff were required, total of 50 staff were permanent staff and 82 were temporary staff which means that, 62% were temporary staff at WMA office.

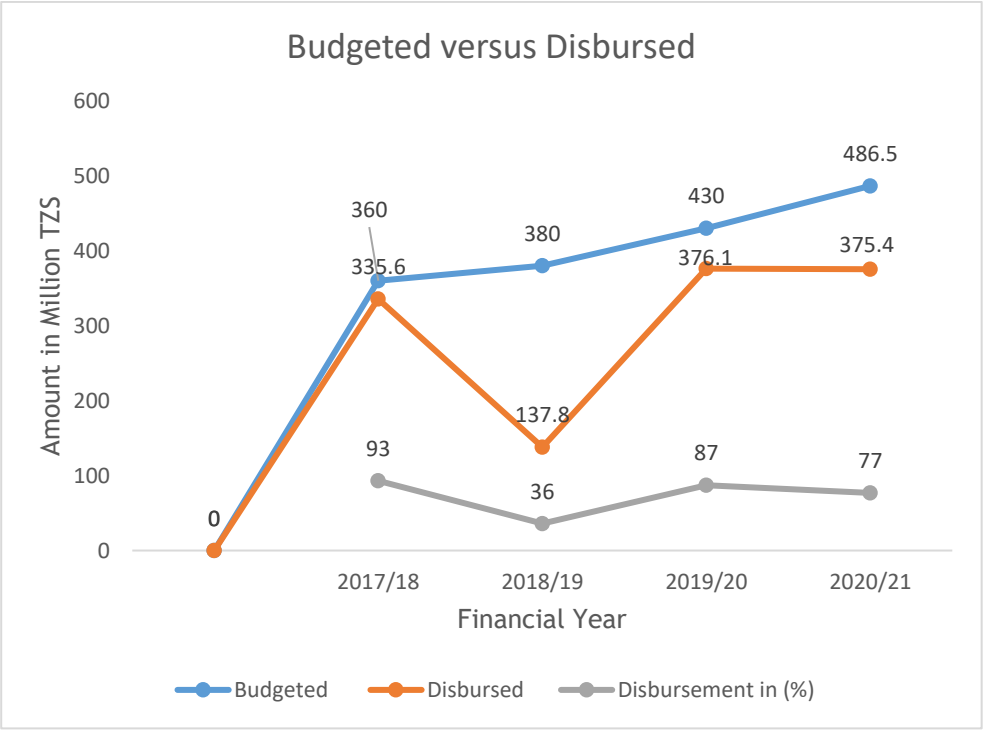
2.5.2 Resources for Implementation of Control Activities at TBS

Financial and Human resources were allocated to TBS Metrology Section for the implementation of scientific and industrial metrological activities as detailed in following subsection:

Financial Resources

Financial resources were normally required for TBS Metrology Laboratory Section to implement Scientific and Industrial metrological activities. **Figure 2.8** presents budgeted versus disbursed funds in the financial year 2017/18 to 2020/21.

Figure 2.8: TBSs' Budget versus Disbursement in the Financial Years 2017/18-2020/21



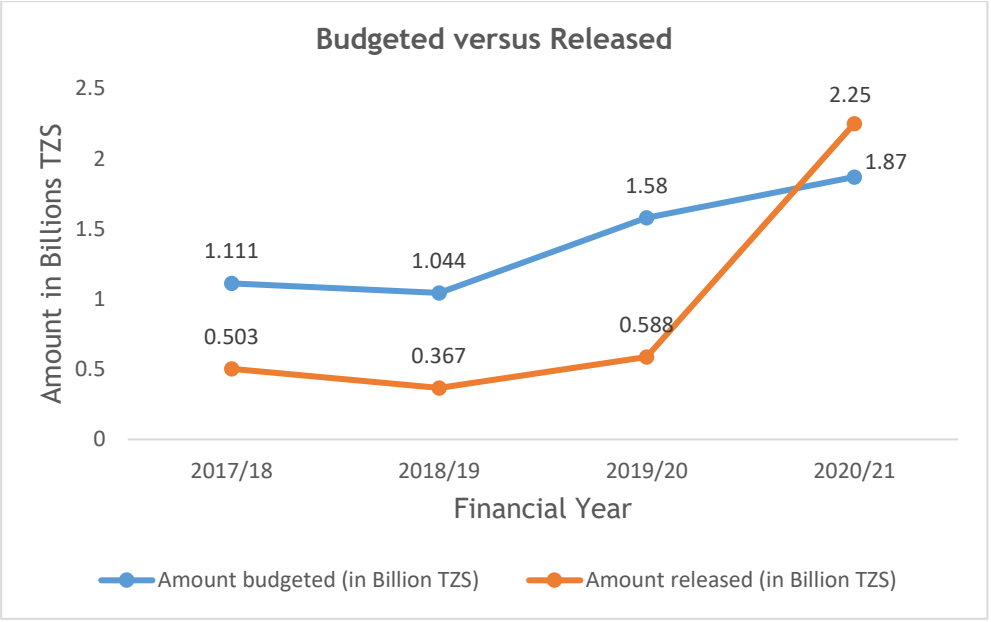
***Source**: Auditors' Analysis Based on TBS Metrology Section MTEF 2017/18 to 2020/21*

Figure 2.8 indicates that the least of all disbursements of fund in the audit period was in the financial year 2018/19 which was at 36%.

Financial Resources for Procuring Reference Standards

Financial resources were required for procuring reference standards needed for calibrating standards from WMA and other authorities. The budget versus release in the financial years 2017/18 to 2020/21 is presented in **Figure 2.9**

Figure 2.9: Standards Procurement Budgeted versus Released for Financial Years 2017/18-2020/21



Source: *Auditors' Analysis Based on TBS ML Section Budgets 2017/18-2020/21*

Figure 2.9 indicates that the amount released for procuring reference standards were less than the budgeted in consecutive three financial years which are 2017/18, 2018/19 and 2019/20 except in the financial year 2020/21 whereby it exceeded the budgeted due activities of travelling outside the country postponement caused by Covid-19 pandemic. The re-allocation was therefore done to procure reference standards.

CHAPTER THREE

FINDINGS ON THE IMPLEMENTATION OF CONTROL ACTIVITIES ON LEGAL MEASUREMENTS

3.1 Introduction

This chapter presents findings regarding implementation of control activities on legal measurement by WMA. It covers management of secondary and working standards and verification of accuracy (traceability) and verification for accuracy of measuring instruments. The followings were the findings observed by the Audit team:

3.2 Management of Secondary and Working Standards and Verification of their Accuracy (Traceability)

The Audit team examined the extent which WMA managed standards by assessing the extent which their performance records were kept and verification of their accuracy (traceability) both secondary and working. The following were noted:

3.2.1 There was no Formal Database for Keeping Record of Standards and their Performance and Number of Measuring Instruments Needing Verification

Part 3.1.1 (iii) of WMA 2018, approved Functions and Organization Structure requires record of standards and their performances to be kept.

Based on the review of standards record files it was noted that there was no formal database to capture the performance status of secondary standards at WMA HQ. Moreover, there was no information of the availability of the working standards in visited WMA regional offices.

Because of this, status of standards was captured only when inventory was conducted.

As a result, it has been difficult to assess the performance of standards both at WMA Headquarters and at its regional offices.

3.2.2 WMA did not Timely Conduct Comparison of Secondary Standards against National Standards

Section 7 (2) (a) of Weights and Measures Act, Cap 340 of 1982, requires periodic verification of Secondary Standards to be conducted once in every two years. The Act further requires secondary standards to be compared with the National Standards and, if necessary, be corrected and adjusted by the Tanzania Bureau of Standards or any other competent institution.

Review of secondary standards calibration certificates issued by TBS revealed that, the secondary standards at WMA HQ were verified for their accuracy (traceability) at intervals exceeding two years contrary to the requirements. The intervals and the respective financial years are presented in **Table 3.1.**

Table 3.1: Verification for Accuracy (Traceability) of Secondary Standards at WMA HQ for Financial Years 2017/18-2020/21

Secondary Standard Calibrated	Verification Interval (months)	Delay in Verification
Set of Weights (1mg and 10,000g)	32	8 months
Set of Weights (20mg-50mg) and (1g-10,000g)	33	9 Months
Stainless Steel Weight (20Kg)	36	12 months
Rule Range(0-1000)mm	36	12 months

Secondary Standard Calibrated	Verification Interval (months)	Delay in Verification
Capacity Measure (5L)	36	12 months
Capacity Measure (4, 2, 1, 0.5, 0.2, 0.1, 0.05L, 0.02L, 0.01L, 0.005L, 0.002L, 0.001L)	36	12 months
Weight (50,000g)	48	24 months

***Source**: Auditors' Analysis Based on WMA's Certificates of Calibration, 2021*

Table 3.1 indicates that secondary standards at WMA HQ were not timely verified. The verification for accuracy (traceability) of secondary standards were delayed by 8 to 24 months beyond the required interval of 24 months. In addition, the weight secondary standard of capacity 50,000 g was only calibrated once in the 2018/2019 throughout the entire period of years which covered by this audit.

Interviews with WMA officials noted that, delay or untimely verification of secondary standards in the respective financial years was caused by the delayed calibration service conducted by the TBS. Since TBS was an external entity WMA was not able to control the timeliness in verifying the standards. The Audit team however did not find any close follow-up and reminder to ensure TBS timely calibrate their secondary standards.

Delayed verification of secondary standards at WMA HQ implied that the working standards at WMA regions which were verified for accuracy in the respective financial years were likely to be verified with unverified secondary standards.

3.2.3 WMA Inadequately Verified Accuracy (Traceability) of Working Standards

Section 10 (2) of Weights and Measures Act Cap 340, 1982 requires that, working standards to be compared with the secondary standards once at least in every twelve months and if necessary be corrected and adjusted.

According to the reviewed implementation reports and verification certificates three challenges were noted in three categories as presented hereunder:

(i) Inadequate verification of mass working standards;
(ii) Inadequate verification of volume working standards; and
(iii) Inadequate verification of length working standards.

(i) Inadequate Verification of Mass Working Standards

Section 10 (2) of Weights and Measures Act, Cap 340, 1982 required that, once at least in every twelve months the working standards which have been in use during the past twelve months, should be tested and compared with the secondary standards and if necessary be corrected and adjusted.

Review of Working Standards Verification Certificates noted that, WMA did not verify all the mass working standards. During the Audit WMA could not provide evidence of some of WMA regions to show that they verified their mass working standards. The situation is presented in **Table 3.2.**

Table 3.2: Verification Status of Mass Working Standards in 2017/18 to 2020/21

WMA Region	Verification Status				No. of non-verification Status of the Mass Working Standard
	2017/18	2018/19	2019/20	2020/21	
Pwani	Yes	No	Yes	Yes	1
Mtwara	Yes	No	Yes	Yes	1
Kinondoni	Yes	Yes	Yes	Yes	0
Mwanza	Yes	Yes	Yes	Yes	0
Kilimanjaro	Yes	Yes	Yes	Yes	0
Ilala	Yes	Yes	Yes	Yes	0
Tabora	Yes	Yes	Yes	Yes	0
Temeke	Yes	Yes	Yes	Yes	0
Dodoma	Yes	Yes	Yes	Yes	0
Tanga	Yes	Yes	Yes	Yes	0

Source: *Working Standards on the Verification Certificates*

Based on **Table 3.2,** Pwani and Mtwara did not verify its mass working standards for one financial year which are 2018/19. The best performance was with Tabora, Temeke, Dodoma, Kinondoni, Mwanza, Kilimanjaro, Ilala, and Tanga which managed to verify their mass working standards throughout the entire Audit period.

Interviews with officials noted that, the reason for Pwani and Mtwara being in worst performance as compared to the other regions was because of lack of proper documentation system. Apart from that, the Audit team did not find evidence at WMA HQ such as copy of the certificates and dispatch as back up.

Unverified mass working standards were likely to affect fairness to buyers in trades, especially if accuracies were out of allowable tolerances since

unverified instruments also give false measurements to the buyers. In addition, the weight measuring instruments giving false measurement have significance impacts in social, health and economy.

The regions covered in this audit have crop selling centres for which millions of kilogrammes of their main agricultural products were sold e.g., cashew nuts in Mtwara, sisal in Tanga, coffee in Kilimanjaro and cotton in Mwanza.

Apart from weighing the crops produced, there were also retail traders. Therefore, without adequate verification for accuracy of mass working standards, the used weight measuring instruments could lead into loss of revenue for the Government and general public on these activities.

Non-traceability of weight used to verify weighbridges would lead into excessively loaded vehicles passing on roads. Excessive loading beyond designed maximum loading capacity of roads would accelerate damage to road networks.

(ii) Inadequate Verification of Volume Working Standards

Based on review of Working Standards verification Certificates in the visited WMA regions the Audit team noted that, volume working standards such as proving tanks and glass measuring cylinders were not adequately verified. **Table 3.3** presents the analysis made to determine verification status of proving tanks as volume working standards and the corresponding financial years.

Table 3.3: Proving Tanks Verification Status for Accuracy in 2017/18-2020/21

WMA Region	Status of Verification				No. of non-verification status of the volume working standard
	2017/18	2018/19	2019/20	2020/21	
Kinondoni	Yes	No	No	No	3
Ilala	Yes	No	Yes	No	2
Temeke	Yes	No	Yes	No	2
Tanga	Yes	Yes	No	No	2
Mwanza	Yes	Yes	NA	No	2
Pwani	Yes	No	Yes	No	2
Tabora	Yes	No	Yes	Yes	1
Dodoma	Yes	Yes	Yes	No	1
Kilimanjaro	Yes	Yes	Yes	No	1
Mtwara	Yes	No	Yes	Yes	1

***Source**: Auditors' Analysis Based on Verification Certificates from the Visited WMA Regions*

Key:

NA: means that evidence was not availed, it also means Standard was not verified

Table 3.3 shows the performances related to verification of the proving tanks. Kinondoni region did not verify proving tanks in three financial years since in three years certificates showed non-verification. In Ilala, Temeke, Tanga, Mwanza and Pwani for three up to four financial years proving tanks were not verified because in two years the certificates showed non-verification whereas in one year there was no evidence to show that the verification was conducted. In Tabora, Dodoma, Kilimanjaro and Mtwara regions did not verify their proving tanks in one financial year. There were other important volume working standards which were supposed to be verified, these include the Measuring cylinders and check pumps. Based on

review of WMA reports it was observed that, the check pumps were verified while the measuring cylinders were not verified.

Non-verification of volume working standards such as proving tanks and measuring cylinders was caused by short supply of such working standards in all regions, as results different WMA regions had to share these instruments. The management of those instruments by sharing was not adequate to the extent that verification exercise was not effective. This may have resulted to unfair transaction to traders, customers and manufacturers.

(iii) Inadequate Verification of Length Measuring Working Standards

Review of working standards verification Certificates of the visited WMA regions noted that, the length measuring working standards in all the visited WMA regions were not verified for accuracy (traceability). This implies that standard meter rules in the visited WMA regions were not verified for accuracy before they were used for verifying consumers' length measuring instruments.

Because of that the unverified length measuring instruments which were tape measures gave doubted measurement results which ultimately may have led to unfair transactions.

3.3 Verification for Accuracy of Measuring Instruments

The Audit team examined verification for accuracy of measuring instruments which include assessing the extent which the measuring instruments were pattern approved; verified/re-verified to protect consumer; WMA monitored calibration conducted by private practitioners and approval of technical drawings and structures of flow and volume.

3.3.1 Inadequate Pattern Approval of Measuring Instruments

Section 18 (2)(a) of Weights and Measures Act, Cap 340, 1982 required that weight, measure, weighing or measuring instruments to be pattern approved by the Minister before they are used for trade.

Pattern Approval refers to control mechanism at which a new measuring instrument is checked its capability of retaining its calibration over range of environmental and operating conditions before it is allowed to enter into the country's market.

According to the review of patterns approval records, the Audit team noted that, there were patterns that were used without pattern approval.

Up to time of this audit WMA HQ had provided 199 pattern approvals which involved seven categories of measuring instruments as presented in **Table 3.4**. However, review of OIML Recommendations document[10] noted that, WMA was required to approve 39 categories of measuring instruments. This indicated that, WMA managed to give patterns approval on 7 out of 39 which was equivalent to 18% the remaining 82% were not pattern approved categories of measuring instruments.

[10] *https://www.oiml.org/en/oiml-cs/categories*

Table 3.4: Pattern Approval Given by WMA HQ

Categories of Measuring Instruments	Number of Provided Pattern Approval
Fuel Dispenser	7
Flow meter	12
Water meter	59
Weigh scale	112
Dipping tape	6
Digmatic calliper	2
Electronic spring balance	1
Total	**199**

***Source**: Auditors' Analysis Based on Patterns Approved by WMA HQ, 2021*

Table 3.4 shows that WMA HQ managed to provide 199 pattern approvals with a range of 1 to 112 on electronic spring balance and weigh scale respectively.

Interviews with WMA-HQ officials noted that, the reasons for inadequate provision of the pattern approval of all categories was contributed by lack of detailed analysis by WMA to assess the national picture of presence and the types of measuring instruments which were used in the country.

Because of that, there was potential risk that the measuring instruments entered in the markets without approval of its pattern could be operating illegally and subject to be seized or face other legal actions. This would create loss to the traders, suppliers or manufacturers or the users of those measuring instruments. Meanwhile, operating with measuring instruments which were not pattern approved could also lead into unfair transactions and tax collection because these instruments may not be able to maintain accuracy at different environmental and operating conditions.

3.3.2 Inadequate Regular Review of Old Patterns

Part 3.1.1(v) of Functions and Organization structure of WMA of 2018 requires approval of new patterns, review of old ones and their records be kept.

Based on the review of patterns approval reports at the WMA HQ and visited WMA regions, it was noted that, WMA did not review old patterns and keep records. The Audit team did not find evidence to show that WMA reviewed the old patterns. However, interviews with WMA officials of the visited regions noted that, they verbally reviewed the old patterns by communicating any pattern that seemed to have challenges to the HQ and the HQ was the one responsible for inspection, testing and certification (approval).

The Audit team further requested for all old patterns at WMA HQ from each category of measuring instruments for the purpose of reviewing, however the records were not availed.

Interviews with WMA officials at WMA HQ noted that, non-review of old patterns was caused by absence of the plans which contributed by non-prioritisation by WMA as they were not proactive, waited for the problem to occur first or the WMA regions to identify the challenging old patterns and react accordingly.

3.3.3 Inadequate Re-Verification of Measuring Instruments by WMA

Section 10(1) of the Weights and Measures Act, Cap 340, 1982 states that, every inspector shall be provided with proper and sufficient working standards of weights and measures to be used for verification and re-verification of weights or measures or instruments in use for purposes of trade.

Based on review of Annual Plans and Performance Reports of the visited WMA regions, the Audit team noted that, WMA conducted re-verification of measuring instruments according to set targets and there were instances when their performance exceeded the set targets. Notwithstanding, the Audit team was not able to assess the performance of initial verification and re-verification of measuring instruments separately. This was because WMA in their reporting system did not separate these two functions. As a result, WMA reported and presented them all as verification. For example, it was difficult to assess the verification performance of water meters in all WMA regions visited. This was because, the existing database for number of water meters present in each region did not indicate whether these meters undergone initial verification or re-verification. It only indicated what was verified.

Review of Annual Performance Reports noted that, water meters verification numbers of WMA regions contained both initial and re-verification numbers all combined together. This practice was caused by lack of comprehensive database to capture specific verification numbers of measuring instruments. The practice of mixing up both the initial verification and re-verification data led to challenging environment which limited Audit team from analysing the performance of specific types of verifications. Furthermore, the review of WMA's Performance Reports of the visited regions noted that, in the financial years 2017/18 water meters were all not verified while in the financial year 2018/19 water meters of the visited regions were partially verified for accuracy. **Table 3.5** presents the situation of inadequate verification.

Table 3.5: Inadequate Verification of Water Meters in the Visited Regions in the Financial Year 2018/19

WMA Region	Name of Water Utility	Verified Water Meters	Total Water connections (Number)
Temeke	DAWASA	-	261,294
Kinondoni		-	
Ilala		2,423	
Mtwara	Mtwara	-	13,057
Tanga	Tanga	-	39,646
Mwanza	Mwanza	-	81,310
Tabora	Tabora	-	19,691
Kilimanjaro	Moshi	-	36,379
Dodoma	Dodoma	-	43,837
Total		**2,423**	**495,214**

Source: *Auditors' Analysis Based on WMA Surveillance Reports and EWURA Annual Report of Water Utilities for Financial Year 2018/19*

From **Table 3.5**, it is shown that in the financial year 2018/19, neither the initial verification nor re-verification for accuracy of water meters was conducted to eight (8) out of nine (9) equivalents to 89% of the visited WMA regions.

Interviews with WMA officials noted that, non-verification of the water meters was caused by lack of water meters testing benches in the respective WMA regions at that time.

Tables 3.5 further indicates that in the financial year 2018/19, a total of 495,214 connections water meters were not verified for their accuracy. This implies that the respective customers/consumers were not protected on the issues of measurements.

Based on interviews with WMA officials in visited regions, the Audit team noted the following factors contributed to inadequate re-verification for accuracy of measuring instruments:

(i) WMA did not set realistic targets to verify measuring instruments;

(ii) Inadequate available standards to conduct legal metrological activities; and

(iii) Inadequate employment system at WMA

The contributing factors to inadequate re-verification have been detailed hereunder:

(i) WMA did not Set Realistic Targets to Verify Measuring Instruments

WMA was expected to conduct census to determine the number of instruments requiring verification, re-verification and use it as a benchmark for a realistic need during planning. It was expected to find and use data from respective regulating authorities such as Energy and Water Utilities Regulatory Authority (EWURA) on water meters, Local Government Authorities (LGAs) healthcare facilities for realistic number of weights measuring scales and Tanzania Electric Supply Company Limited (TANESCO) for number of electricity energy meters. However, interviews with WMA officials noted that, the census was not conducted, and this led to WMA to set low targets in their Strategic Plan.

(ii) Inadequate Available Standards to Conduct Legal Metrological Activities

WMA was expected to conduct needs analysis to establish all needs such as standard equipment, human resources and transportation cars to facilitate verification activities. However, interviews with WMA's regional officials noted that, WMA did not conduct such needs analysis rather they were requesting for standards from WMA HQ whenever they had critical needs. For instance, review of letter[11] from WMA Kinondoni office to the HQ revealed that there was a need of working standards to improve conduction of metrological activities as is presented in **Table 3.6**

Table 3.6: Needs for Working Standards at Kinondoni WMA Region in the Financial Year 2020/21

Name of Needed working standard(s)	Quantities
Proving tank 250 litres	1
Proving tank 500 litres	1
5 kg weights	4
Measuring cylinder	1-set
Range finder[12]	2
Clamp meter for measuring gas flow meters	5
F1 and F2 weights for weighing class I and II	1-set
Inspection kit	2
Disk gauge meter for measuring iron sheets gauge size	2

***Source**: Letter with Ref. No. GA/KIN/253/338/02A/98 Dated 01/10/2020*

[11] Ref.No. GA/KIN/253/338/02A/98 dated 01/10/2020

[12] Measuring instrument for verifying volume of sand and other ballasts

Table 3.7: Needs of Working Standards at Tanga WMA Region in the Financial Year 2020/21

Name of Needed working standard(s)	Capacity	Number needed	Number Availably	Deficiency (Number
Standard beam balance	5Kg	2	0	2
Standard check pump	20L	2	0	2
Standard proving tank	250L	1	0	1
Standard proving tank	500L	1	1	0
Standard meter rule	2M	1	0	1
Standard gauge block	-	1-set	0	1-set
Pycnometer	100mls	2	2	0
Inspection kit	1gm to 2Kg	1-set	0	1-set
Range finder	-	1	0	1

***Source**: Auditors' Analysis Based on Letter with Ref. No. GA/TAN/253/338/02/182 Dated 5/10/2020*

Table 3.6 and **Table 3.7** show that at Kinondoni and Tanga WMA regions there were needs of working standards.

Based on interviews with WMA officials the challenge of availability of equipment depending on the needed type was contributed by:

- Unavailability, as most of them were imported from outside the country and were more specialized; and

- Most of the Manufacturers or suppliers were not willingly and interested to bid on the advertised tenders because of prolonged and many procurement requirements for specialized equipment.

The inadequate number of working standards affects implementation of legal metrological activities by either spending more time than expected for the case of inadequate number and non-verification for the case of missing standards.

(iii) Inadequate Employment System at WMA

Enquiring was made to determine whether needs analysis or projections on the number of staff required was conducted.

Interviews with WMA officials at WMA HQ noted that, the existing staffing model was based on mixing the permanent staff and temporary employed staff. The temporary employed staff have contracts for one year which were renewable based on good performance. From **Table 2.1,** indicates that, the total number of temporary employed staff was greater than that of permanent staff in all 11 WMA sampled areas. The temporary was 71 equivalents to 62% against permanent staff who were 44. The status of employment in each region is presented in **Table 3.8**

Table 3.8: Employment Status of the Weights and Measures Inspectors of the Visited Regions as of December 2021

WMA Region		No. of Needed staff	Inspectors Employment Status		Temporary Employment in Percentage	Total available staff	deficit
			Permanent staff	Temporary staff			
Dar es Salaam	Temeke	26	7	12	63	19	7
	Kinondoni	17	6	11	65	17	0
	Ilala	14	6	8	57	14	0
Mtwara		8	3	5	63	8	0
Tanga		8	3	5	63	8	0
Kilimanjaro		13	5	8	62	13	0
Mwanza		10	4	5	56	9	1
Tabora		10	6	3	33	9	1
Pwani		29	6	20	77	26	3
Dodoma		11	4	5	56	9	2
Total		**146**	**50**	**82**	**62**	**132**	**14**

***Source**: Auditors' Analysis Based on Interview Minutes of Visited WMA Regional Offices, 2021*

Table 3.8 shows that, Pwani region had highest percentage of temporary employed staff in all the visited WMA regions. Interviews with officials noted that this was because Pwani Region had more metrological activities and workload as compared to other regions. Whereas Tabora region had the least percentage of temporary employed staff. It was further shown that the number of temporary employees in total was at 62%.

Furthermore, interviews with WMA officials noted that temporary employment system was applied to cover the gap of number of inspectors needed to conduct metrological activities.

The Audit team was of the view that, this work required people who are vetted and with higher level of integrity. The regular change of staff at WMA was done with an inherent risk of confidentiality. However temporary employment system had the following significant performance implications:

- When the contracts of staff who work on temporary basis expires. It takes about 3 to 4 months to recruit new group of staff. During this time most of the key activities will be frozen or reduced in scope. For example, the Audit team visited WMA Mbeya regional office during preliminary study in April 2021. At this time all temporary staff contracts had expired, and the office had only one staff. Given this situation, the metrological activities were not conducted for three months.

- Risks associated with confidentiality and integrity for such public service;

- The institution to incur avoidable cost related with employment process every year in every WMA region; and

- Creates inadequate capacity building in terms of working experience.

3.3.4 Unverified Metrological Measuring Instruments by WMA

Based on review of the Annual Plans and Performance Reports of the visited regions the Audit team noted that, there were unverified metrological measuring instruments. The Audit team noted that, WMA could not periodically verify legal metrological measuring instruments as per the Weights and Measures Act Cap 340 of 1982 requirement through the entire audit period. (The Act required all persons who have in their possession any weight, measure, weighing or measuring instrument which is used or

intended to be used in trade, to produce at such time and place to be examined and verified).

WMA did not have data for all unverified instruments. It is because of this, the Audit team could not assess the performance of WMA in relation to all unverified measuring instrument. In addition, based on interview with WMA officials Audit team noted that, WMA did not manage to verify areas of taximeters, pressure gauges and water meters which have diameters exceeding DN 50, however the Audit team enquired performance of the other three measures. These include vehicle speed detection devices; system device of the data and bundle charged by the mobile networks and ports measuring instruments used in quantifying imported fuels such as Hydrometer, Thermometer and Dip Tape. All these Metrological Measuring Instruments were not verified by WMA. The consumer was not adequately protected and assured on the quality and quantity served.

The preceding section provides the status of verification of aforementioned key instruments.

(i) Non - Verification for Vehicle Speed Detection Devices

Review of WMA Performance Reports of the visited WMA regions noted that, WMA did not verify the speed detection devices.

Interviews with staff pointed out that, the factor contributed to not verifying and re- verifying the vehicle speed detection devices was lack of the regulation guiding the verification of the measuring instruments; and lack of capacity in term of both secondary and working standards to verify or re-verify the accuracy of the vehicle speed measuring devices.

Non-verification and non-reverification for accuracy of the speed detectors created uncertainty environment for the drivers who are charged for over

speeding defaults and being penalised by traffic polices whether are fair or unfair.

(ii) Non-Verification of the Water Meters Diameter Exceeding DN 50

Interviews with WMA officials pointed out that, water meters of diameters exceeding 50mm (DN 50) were not verified due to lack both secondary and working standards to verify such kind of water meters.
Non-verification of water meters of diameters exceeding 50mm (50 DN) this means that, WMA did not check or re-check the accuracy of the amount of transferred water through metering measuring instruments. This led to created potential unfair billing of water that pass through meters.

(iii) Non-Verification of Measuring Instruments at Ports of Entry

All the measuring instruments at ports were not verified, these includes Thermometers, Dip Tapes, Hydrometers, and SBM flow meter.
Based on review of WMA report and Interviews with WMA officials, the Audit team summarized the following factors to have been contributed to the non-verification of the port measuring instruments.

a. WMA did not have capacity to verify the port measuring instruments. Interviews with WMA staff pointed that, because of lack of that capacity consumers were advised to use TBS or other entities abroad to verify their equipment.

b. WMA focused to approve the end results of the petroleum products measured rather than verifying the measuring instruments.

c. Unclear division of responsibilities between WMA regional offices and WMA port unit office. The reviewed organization structure showed a conflicting role of the port unit in relation to conducting

metrological activities. The Audit team noted that, the role of port unit was on metrological supervision of the imported oil, petroleum, and natural gas. WMA Temeke regional office, according to the approval organisation structure was responsible for conduction all metrological activities including verification of the measuring instrument at port of Dar es salaam. However, the Audit team noted that Temeke WMA regional office did not verify the measuring instrument. As a result, there was no assurance of volume measured by the port instruments. This would lead into incorrect measurement and affect taxes collected by the government.

The Audit team acknowledged efforts by the Government to accomplish construction of the fiscal metering systems which are used to measure all imported and exported petroleum products at Kurasini Oil Jet (KOJ), Dar es Salaam, Tanga and Mtwara Ports.

3.3.5 Inadequate Monitoring of Calibration of Volume and Flow Measurement Conducted by Private Practitioners

Part 3.1.3 (viii) of Approved Functions and Organization structure of WMA of 2018 requires WMA to monitor the calibration of volume and flow measurement meters conducted by private practitioners.
Review of private practitioners' records at WMA HQ and the visited WMA regions noted that, WMA did not adequately monitor calibration of volume and flow measurement as there was no evidence of monitoring conducted.

According to the interviews with WMA officials Audit team noted that, the practise was that the private entity informed WMA about their plan to make calibration of instruments. Then WMA ensured to have their representative who would act as an observer to ensure all the calibration protocols are observed. Thereafter, WMA stamps the documents of compliance. However, this practice was not documented. In addition, there were no reports to

show the number of private firms attended and the rate of compliance and rejection. This limited WMA to monitor the private entities.

Lack of monitoring creates a risky environment as it may lead to inadequate calibration which ultimately may result to false measurements. This may have significant negative impacts throughout the entire re-verification for accuracy interval of five (5) years.

3.3.6 WMA did not Approve Technical Drawings and Structures of Volume and Flow Measures

Part 3.1.3 (i) of Approved Functions and Organization structure of WMA of 2018 requires technical drawings and structure of volume and flow measures to be approved by WMA.

Review of progress reports from both WMA-HQ and at regional offices showed that, there was no documented evidence to show that WMA approved the technical drawings and structures of flow measures. This includes the bulk storage tanks and fixed storage tanks.

Although review of technical drawings and structure of volume and flow measures were not legal metrological features, WMA were supposed to coordinate with the approving authorities such as EWURA in this process. This was because the assurance of legal metrology requirement was done at a later stage after fabrication. There should be any deficiencies in the technical drawings and structure of volume and flow measures would also affect the wok of WMA. However, the Audit team did not find the evidence which shows coordination of the WMA and other actors which deal with inspection of the technical drawings and structure of volume and flow measures.

WMA did not prioritize this important activity for country's economy since, despite its likely impact; it was not included in the plans and budgets. As a result, all structures especially the fuel tanks were not verified on their compliance with drawing and constructed tanks may give false measurement of the amount of volume contained in it.

CHAPTER FOUR

FINDINGS RELATED TO THE INSPECTION OF PRE-PACKAGE OF GOODS

3.4 Introduction

This chapter presents findings of implementation of control activities on legal metrology requirements for pre-package products[13] to the industries; households and farms produce prior reach to consumers. This includes imported goods and those produced or manufactured within the country. It deals with aspect of labelling and packaging of the products. The findings cover control of labelling, verification of products produced/manufactured by local industries and control of packaging of the farm producers. The details are as shown hereunder:

3.5 Inadequate Control of the Labelling of the Products

Reg. 182(1) of the General Regulation of Weights and Measures, 2019 requires; a pre-packed product to bear a declaration of the net quantity of the product on the principal panel.

It was observed that, there were products taken to the marketplace without proper declaration of the net quantity through labelling. This was physically observed in the visited markets[14] which sold farm produces to the customers and the products that were seized by WMA during surprise inspection as shown in **Photos 4.1(a) and (b)** below.

[13] Also called pre-package commodities or pre-package goods
[14] Team made a general survey on the markets of Mabibo in Dar es Salaam, mwanza centre, Ngamiani in Tanga, Isevya in Tabora and Sabasaba in Dodoma.

	
Photo 4.1 (a): Shows improper labelling on bottle of water. Photo taken by auditor; 23th September, 2021.	**Photo 4.1 (b):** Shows containers lacking labelling. Photo taken by auditor; 08th October, 2021.

The Audit team noted that, these unlabelled products deny consumers the information on net content in volume or weight. In additional, the presence in the markets of unlabelled products was linked with inadequate enforcement by WMA.

Review of progress reports also showed that, WMA did not have a strategy for conducting public awareness campaign. In addition, interviews with customers at the markets showed that, the general public who are the consumers of these products were not aware or not curious in checking the quantities of items.

The Audit team noted that, there were other products which were well labelled its net weights that were lower than the weights shown in the cover. The problem was worse in Mwanza, Dar es Salaam as compared to Tabora and Pwani region.

The Audit team noted that, WMA did not impose deterrent sanctions for non-compliance. The common sanction given was only the verbal warning

to non-compliant (Traders and manufacturers), because of the weak sanctions to non-compliant, problem prevailed and affected the consumers as well as the producers had no fear of being caught.

Furthermore, Table IA of the General Regulations of the Weights and Measure, 2019 showed how the units of measurement should be shown as presented in ***Appendix 6*** of the OIML R 79:2015 (E).

Apart from addressing the issue of right labels or right quantity, the Audit team also observed that, the writing of units did not conform to the standards on some products. The standard requires that there should be a single space between the number and the unit of measurement.

Based on field observations in all visited regions the marketplaces were flooded with products which did not comply with this standard requirement. **Photos 4.2 (a) and (b)** show some product's labels that were written without appropriate separation of unit of measurements and the number.

	
Photo 4.2 (a): Shows error on spacing between dimension and its unit. Photo taken by auditor; 02nd June, 2021.	**Photo 4.2 (b):** Shows error on put in place unit of measurements. Photo taken by auditor; 02nd June, 2021.

Based on interviews with WMA officials, the WMA did not properly control the labelling process. The products entered in the markets without approval or verification for compliance with label by WMA. This weakness to some extent was due to inadequate inspection and limited awareness campaign to the general public.

The implication of this issue includes misleading purchasers with respect to the quantity of products contained. Moreover, products lacking export criteria, which lead to failure as country for our products to compete with other countries' products.

3.6 WMA did not Adequately Inspect Goods in Number of Industries in Previous Financial Years

Reg. 175(1), PART XXII of the General Regulations of the Weights and Measures of 2019 requires that, goods produced, manufactured, or packed locally or otherwise to be subject to inspections, testing and certification by the inspector at least once in every year.

However, review of registers, pre-package reports and letter of appointment of the inspection in the visited WMA regions of the pre-package of goods noted that, WMA did not inspect all goods in the industries as shown in **Table 4.1** hereunder:

Table 4.1:Performance of Inspection of Manufacturing Industries

Region Name	Number of verified industries 2021	No. of the manufacturing industries in the region, 2021	Percentage of performance (%)
Mwanza	102	2,708	3.8
Dar es Salaam	497	14,519	3.4
Tabora	48	1,614	3.0
Kilimanjaro	69	2,699	2.6
Mtwara	31	1,423	2.2
Tanga	47	2,580	1.8
Pwani	34	2,584	1.3
Dodoma	28	2,806	1

Source: *Analysis of the Pre-Package Reports and Report of the Industrial Mapping Desktop Survey Published in August, 2021*

Based on **Table 4.1:** it can be seen that, WMA inspected only 2.8% of the manufacturing industries in selected regions. The proportion of inspected industries varied from 1% to 3.8%. In addition, the data which shows reported number of industries in every region as reported by MIT is shown in ***an Appendix 7*** and its summary shown in ***Appendix 8***. However, according to the interviews by WMA officials it was noted that, data pertained with the number of the industries in each sampled regions were different as compared to source reported by MIT and data from Regional Secretariat. For example, the data from the Regional Secretariat in Pwani Region reported that, the total number of the industries was 1,449 compared 2,584 as reported by the MIT.

Furthermore, Audit team reviewed the extent to which WMA conducted re-inspection of pre-packaged goods in regions and observed that, WMA did not adequate re-inspect pre-packed goods in the industries at least once in

every 12 months every year from 2017 to 2021. The situation of re-inspection is presented in **Table 4.2.**

Table 4.2: Performance of Re-Inspection of Manufacturing Industries in 2017 to 2021

Visited WMA Region	Number of Visits to the Industry					Total No. of Re-inspection in the last 5 Years
	Visited Every Year	Visited once in the 5 Years	Visited 2 times in the last 5 Years	Visited 3 times in the last 5 Years	Visited 4 times in the last 5 Years	
Kinondoni	0	197	76	24	5	302
Ilala	0	79	17	4	0	100
Temeke	14	146	78	33	24	295
Tanga	11	17	7	5	7	47
Mwanza	1	43	36	13	7	100
Pwani	0	26	6	1	0	33
Tabora	0	32	14	2	0	48
Dodoma	0	27	1	0	0	28
Kilimanjaro	3	37	15	10	4	69
Mtwara	1	21	8	0	1	31

***Source**: Pre-Package Inspection Reports of Visited WMA Regions for Calendar Years 2017 to 2021*

From **Table 4.2**, it is shown that 5 out of 10 which is equivalent to 50% of the visited WMA regions did not re-inspect the companies every year of audit period. The remaining 50% of the visited regions re-inspected the companies once, 2 times, 3 times and 4 times. These re-inspected once were leading by having greater number followed by 2 times re-inspected, followed by 3 times and the least were 4 times re-inspected.

According to interviews by WMA officials, this situation was because WMA had limited human resources to cover all factories. However, the Audit team

noted that, WMA did not even have the database of manufacturing factories in their areas for follow-up and strategize planning of inspections.

As a result, WMA also losses potential revenues through inspection fee paid by verified industries. According to review of implementation reports, the average verification fee per one factory for one year was TZS 83,451.09 for small industries and TZS 4,922,994.23 for large industries. Based on Table 4.1, a total of 30,077 factories were not verified in the calendar year 2021. This amount was estimated to range from approximately TZS 2.5 to 148 billion per year for the small and large factories respectively. Further details of calculations are shown in ***Appendix 9***.

3.7 Inadequate Management of the Packaging of the Farm Produces

Section 2(1) of the Weights and Measures Act (Amendment) Order, 2018 pointed out that; the packaging of farm produce shall be in weight, number, volume or length. In addition, farm produce packed in- weight shall not exceed the weight of 100kg, with tolerance of +5.

In all visited regions the Audit team observed the farm produces exceeding 100kg. The Audit team reviewed compound forms in all visited WMA regions and noted that the weight was ranging from 110kg to 145kg. The problem was prominent in Mwanza and Dar es Salaam Regions as compared to Pwani, Kilimanjaro, Dodoma, and Tanga Regions.

The Audit team noted that, WMA did not have full control on this problem because most of the farm produces are packaged in farms whereby mode of selling and buying do not use measuring instruments. It was only measured in sacks. However, based on interviews with WMA officials, little awareness campaigns to farmers were done by WMA concerning the need of selling their produces using weight other than selling from unmeasured sacks.

The consequence of this is those farmers did not get the maximum profit from their produces, whereas more profit was likely to be accrued by brokers and traders who sell these products by weights.

CHAPTER FIVE

FINDINGS RELATED TO THE SURVEILLANCE AND INSPECTIONS OF THE MEASURING INSTRUMENTS

5.1 Introduction

This chapter presents findings pertaining to adequacy of surveillance and inspection aspects. The following were noted:

5.2 Adequacy of the Surveillance Aspect

This cover findings of surveillance and reporting system, activities to raise public awareness on legal metrology activities and Findings on fulfilling other assigned responsibilities. The findings are as detailed below:

5.2.1 Lack of Strong Surveillance and Reporting System

According to the objective D of the WMA's Strategic Plan (2018/2019—2022/2023), WMA was required to establish metrological requirement conformity. This includes establishing the tracking system for weights and measures activities to harmonize and improve metrological supervision and expertise on measurements.

Review of the implementation reports showed that, there was inadequate surveillance and reporting system. The current reporting system was paper based both from regions and surveillance section to the technical management. This mode of reporting was contrary to the planned comprehensive web-based reporting framework. The manual submission of the surveillance reports affected WMA to make the timely decision because of some of these reports were delayed or lost. Lack of a web based reporting system was a reflect of less priority given in the budget as a result

takes long time for data to be collected, prepared, and dispatched to the next administration.

5.2.2 Inadequate Public Awareness on Legal Metrological Activities

Surveillance Section was mandated to collaborate with the Communication and Public Relation Section to plan and develop ways and methods of conducting public awareness on legal metrology activities. Furthermore, Regional Managers were required to educate current and potential customers (public awareness on legal metrology issues).

Review of the implementation reports showed that, at visited regional offices, WMA did not conduct fully public awareness on legal metrology issues. Based on review of the regional annual action plans, the plan did not include the activities of educating customers. This is contrary to the WMA strategic plan 2018-2023 which demand each regional office to increase public awareness on Weights and Measures Agency's services.

Based on review of WMA budget and disbursement trends, the Audit team noted that on average WMA received above 80% of its budget (refer Figure 2.7). However, out of these activities related to support public awareness was not prioritized in the budget. The Audit team noted that, the Communication and Public Relations section (CPR) managed to plan for public awareness, but the plan was not adequately implemented partly because of lack of funding also because its preparation was not integrated with activities from the surveillance sections who are also doing a similar activity. As a result, the general public who were the consumers such as farmers and retailers were not aware about metrological issues like checking accuracy of the metrological measuring instruments.

5.2.3 Inadequate Fulfilment of Assigned Responsibilities

Surveillance section was required to undertake comprehensive watchdogging on implementation conducted by the regional managements particularly on metrological inspection of the pre-package goods, measuring instruments and system. However, the Audit team noted that, surveillance section did not effectively perform assigned roles.

According to the documents reviewed Audit team noted that, Surveillance section did not adequately monitor metrological inspection of the pre-packages goods and measuring instruments and system in the country. This was evidenced based on unsatisfactory actual performances of the regional managements on conducting verification, re-verification and inspection of the metrological measuring instruments as detailed in **Chapter 3 and 4.**

In addition, surveillance section was required to scrutinize, analyse and compile technical and operation reports from the regions and advice accordingly. However, it was observed that the surveillance section did not effectively perform these roles, because there was no any documented technical report prepared as an advice to technical director and regional managers.

Furthermore, it was noted that, at the large extent surveillance section managed to facilitate the issuance and renewal of licences to practitioners of legal metrology due to the fact that, they managed to put control on all private practitioners to renew their licence once every year. However, based on aforementioned succession the challenge was on monitoring of the activities conducted by the licenced private practitioners as detailed in sub **Section 3.3.5.**

5.3 Adequacy of the Inspection Aspects

This section presents findings pertained to inspection of the metrological measurement which undertaken by the WMA regional managements. During the Audit, the following areas for improvement were observed.

5.3.1 Inadequate Source of the Information Providers

According to the best practice WMA was required to designate the focal points with intention to provide information into WMA in the areas of safety, environment, health, and business to report non-compliance issues including the inaccuracy and misconduct cases. Private practitioners can also be designated as active informers. The outsourced information providers and the private practitioners can assist with early detection, notification and investigation of all matter related to the metrological measuring instruments.

Reviews of implementation reports showed that, WMA did not establish a system that includes informers as source of information for their enforcement. As a result, its scope of getting information concerning illegal use of measuring instruments was limited. Since WMA has not enough personnel to cover large part of areas for inspection, it has been difficult to control the illegality.

Based on interviews with WMA officials, WMA through regional offices coordinate with LGA as part of sensitization to the general public to bring their measuring instruments for verification. However, this coordination approach was not effective to help WMA in fighting the allegation of unfair transactions.

Based on reviewed documents, it was noted that, causes for not instituting a system for recruiting informers was that, WMA did not plan for these

activities and have not assessed the cost and benefit and other scenario to compare operation with informers and without informers. This implied delay in providing protection to the customers due to the lack of the information providers.

In addition, the Audit team noted that, the management of the +0800110097 toll free number was not effective. It does not help to fast track the action be taken after receiving any call. This was because, the toll free call was centralized, and it was only the office of the Chief executive officer which could access it. Then, the collected information was shared to responsible managers to solve it. Ideally, it was expected that the toll free call to be general by front desk officer who would document the issues and inform each responsible manager.

5.3.2 WMA did not Map the Areas for Inspection in order to Select Risk Areas

Reviews of the inspection and implementation reports Audit team noted that, WMA did not establish mapping tools. In normal practice it was required that, WMA to select risk areas which needs intensive inspection rather than conducting inspection without proper plans. Based on interviews made with WMA officials it was noted that, the approach used by WMA relied on the proceeding of post-inspection of where they ended in previously verification in order to inspect for those who escaped to verify their measuring instruments.

Factor contributed to the lack of generation of mapping tools was due to failure to conduct needs analysis. This means that, the situation led to potential impact of inspecting at improper area of jurisdictions.

CHAPTER SIX

FINDINGS RELATED TO IMPLEMENTATION OF NATIONAL METROLOGY LABORATORY AND TRACEABILITY

6.1 Introduction

This chapter presents findings on the performance of TBS as a National Metrology Institute (NMI) and on control activities of scientific and industrial measurements.

The findings cover capacity of reference standards, accreditation status, Inter-laboratories comparisons of all aspect of the metrological instruments; disseminate Information related to the metrology and implementation of science and industrial metrology control activities. The following was noted:

6.2 TBS did not Adequately Manage to Assume the Custodian Role of the National Measurement Standards of Weights and Measures

Section 4 (1) (l) of the Standards Act, 2009 states the function of TBS among others, was to act as the custodian of the National Measurement Standards of weights and measures.

Reviews of performance reports noted that, TBS did not adequately assume this role. This is because; key metrological activities were not implemented by TBS as NMI. These activities were in the areas of legal, scientific, and industrial metrology. Some, of these activities were delegated to the small section at TBS, the Metrology laboratory Section. Given the small capacity of the Metrology laboratory Section those activities were not efficiently done. In addition, TBS on its role as NMI did not ensure accuracy

(traceability) of standards used for verification. In practise, TBS was required to ensure accuracy of the standards used by WMA.

Based on the review of the TBS organisation structure, this Section is supposed to be headed by the Manager who is part of the management team. Taking into account the importance of the National Metrology Institute (NMI) to the country, having one Head who is supervising all sub - Sections at metrological laboratories implies that, that situations put a lot of pressure to the Head and might lead to inefficiencies. On the other hand, Metrological Section has been functioning since 2018 without a manager and to some of extent that has hampered the performance of the section.

As a result, key decisions concerning metrology, including budget allocation and disbursement, priority setting, procurement of equipment and metrological control activities were not well addressed. However, the post of Metrology Manager was approved in the 150th Board of Directors meeting held on 29th October, 2021 and TBS has already submitted a written request of the post to the President's Office, Public Service Management and Good Governance (PO-PSM & GG) through letter with Ref. No. CBC.98/407/01/30 dated 5th November, 2021.

6.3 Inadequate Capacity in Terms of Reference Standard Equipment /National Measurement Standards

According to OIML document (OIML D1 Edition 2004E) TBS was required to act as National Metrology Institute (NMI) with at least one laboratory. In addition, TBS as NMI was supposed to set up national measurement standards according to country's needs. When relevant, these national measurement standards will be primary realizations of the SI units (or a copy of the international prototype of the kilogram), and in other cases, the national measurement standards may just be secondary measurement standards traceable to primary measurement standards of another country.

Based on reviews of the implementation reports the Audit team noted that, TBS did not establish eight National measurement standards. The measurement standards concerned radiology; sound; lights; viscosity; high voltage; flow rates; frequency in aviation and air quality. As result, there were no references or benchmarks in this country in which these equipment can be tested and calibrated. This was because there were no laboratories for tracing measuring equipment to ascertain their reliability.

Interviews with TBS officials noted that, TBS did not conduct any needs analysis of the required number and/or types of standards equipment. Absence of needs analysis made it difficult to know the gap of the required equipment. This to large extent affected the capacity of TBS to verify all WMA standards, as it had no reference standards. TBS could not procure more reference standards because the release of budget was not sufficient as presented in **Table 6.1** but also complication of tendering of reference equipment in which bidders did not respond to the tender process due to Government's procurement process which normally required payment to be effected after delivery.

Table 6.1: Standards Procurement Budgeted versus Released Variance for Financial Year 2017/18-2020/21

Financial Year	Amount budgeted (in Billion TZS)	Amount released (in Billion TZS)	Variance (in Billion TZS)	Variance in %
2017/18	1.111	0.503	0.608	54.7
2018/19	1.044	0.367	0.677	64.8
2019/20	1.58	0.588	0.992	62.8
2020/21	1.87	2.25	-0.379	-20.3
Total	**5.605**	**3.708**	**1.897**	**34**

***Source**: Auditors' Analysis Based on TBS ML Section Budgets 2017/18-2020/21, 2021.*

Based on **Table 6.1,** TBS's budget for procuring reference standards showed that, from 2017/18 to 2020/21 TBS received fund with a shortage of 34% of the approved budget. In 2020/21 TBS received 20% in excess of the approved amount. According to interviews Audit noted that, the budget surge in this year was because TBS reallocated funds from other activities which were not implemented due to Covid 19 pandemic. Therefore, these funds were re-allocated to the procurement of the reference standards.

The Audit team made analysis for the specific impacts which may be generated due to failure to conduct traceability of the following sampled areas. The results are presented in **Table 6.2** below.

Table 6.2: Implications for Areas of Field not being Able to Conduct Metrology Activities

Areas of Field	Implications for not being able to Conduct Metrology Activities
Radiology	May affect detection, staging and treatment in healthcare
Sound	May affect determination of appropriate noise control measures that need to be put in place
Light	May be difficult to know if the lighting fixtures are performing as expected. That is whether are under or over performing.
Viscosity	In Engineering, engineers' determination to know how a fluid will behave under different circumstances may be affected.
	In pharmacy, determination of a wide range of data points such as at what point can a fluid flow through a syringe may be affected.
	In food industry may affect in maximizing production efficiency and cost effectiveness.
	In the chemical and cosmetic industry, viscosity testing is a very important parameter for quality control. May affect measuring the viscosity of products such as toothpaste, cough syrup or ointment, ink, paint, and coatings, which manufacturers can predict how products will behave once they are in the hands of the consumer.

Areas of Field	Implications for not being able to Conduct Metrology Activities
High Voltages	This is especially important in circuits where large currents are flowing, and the voltage drop across cables and junctions have a big impact.
Flow rates	May be difficult to ensure the volume of fluid that passes through a given cross-sectional area per unit time run smoothly, safely, and cost-effectively.
Frequency in Aviation	It may affect air-to-air communications such as communication between private, fixed-wing aircraft, helicopters, gliders, and hot air balloons because every aspect has specified frequencies.
Air Quality	May affect determination of polluted air which can be bad for people health and the health of the environment

***Source**: Analysis of Interviews Held with TBS Personnel and References Presented on Page 92, 2021*

Meanwhile, the Audit team noted, that in areas where TBS had the capacity to verify accuracy of the standards (traceability), its effectiveness was affected by existence of weak coordination with other agencies enforcing traceability of metrological measurement. For example, there was weak coordination with Ministry of Health, TAEC, CRB, TANROADS, LATRA, Police Department, OSHA, NEMC and TMA. Because of this, TBS could not document more result from these actors. As a result, TBS did not get the national picture of the metrological compliance.

The main reason for the observed coordination inefficiency was lack of regulation or any legal mandate that requires TBS as a National Metrological Institute to do so.

6.4 Half of TBS Metrology Laboratory Activities were not Accredited

According to the international standards (ISO/IEC/17025:2017), testing and calibration laboratories should have an international reference as a way to demonstrate their capacity to deliver reliable results.
Review of TBS as a Metrology Laboratory Accreditation certificates noted that, TBS was not accredited in five (5) out of ten (10) areas of measurement fields which is equivalent to 50%. **Table 6.3** presents different fields and their accreditation status.

Table 6.3: TBS Metrology Laboratory Operating Areas and their Status of Accreditation as of October, 2021

Area of measurement standard	Accreditation Status
Mass	Yes
Volume	Yes
Temperature	Yes
Dimensional	Yes
Time and frequency	Yes
Pressure	No
Electrical	No
Chemical	No
Force and Torque	No
Density	No

***Source**: Auditors' Analysis Based on Metrology Laboratory Accreditation Certificates 2021 and Interview Minutes with TBS Metrology Laboratory Officials, 2021*

Table 6.3 clearly shows that, half of the ten important areas of measurement standards lack accreditation of these measurement standards. The five areas which TBS had been accredited, upon further inquiry, the Audit team noted that, the accreditation was not made to scopes per each area. For example, only few spectrums of volumes, mass and temperature were accredited. Inadequate accreditation of TBS

laboratories was contributed by lack of qualified personnel who are well trained in the respective areas. Also, based on interviews with TBS officials, TBS was not well prepared by properly documenting system to capture or comply the methodological requirements for accreditation.

Lack of presence of accredited laboratories within TBS, means that customers would send their instruments abroad for calibration. This would result into loss of the revenue to TBS and the Government. However, Audit team did not find the evidence to show involvement of TBS on ratifying the results that come from abroad. This situation may also affect investors to come and invest in our country with a fear of lack protection of the measurements instruments.

6.5 Inadequate Inter-Laboratories Comparisons of all Aspect of the Metrological Instruments

According to the Para 7.7.2 of the BS EN ISO/IEC 17025:2017, the laboratory was supposed to monitor its performance by comparison with results of other laboratories, where available and appropriate through participation in inter-laboratory comparison.

Based on review of the quality management documents, in all years covered in this Audit, TBS did not adequately conduct inter laboratories comparisons of all aspect of metrological instruments.

According to the interviews it was noted that, comparison was not made because TBS did not have reference standards in some of the field areas like electrical, chemical, force, torque and density. Lack of these led to non-accreditation of TBS. As a result, TBS could not adequately demonstrate its capabilities in term of reference standards and maintain quality of laboratory performance.

6.6 TBS did not Disseminate Information Related to the Metrology

Para II.2 of the OIML (International Organization of Legal Metrology) D 1, Edition 2004 (E) revealed that, TBS was supposed to conduct development, maintenance, and dissemination of those national realizations of the units and quantities of the SI measurement standards at a level sufficient to support national needs. In addition, TBS required conducting information dissemination to the public about metrological issues.

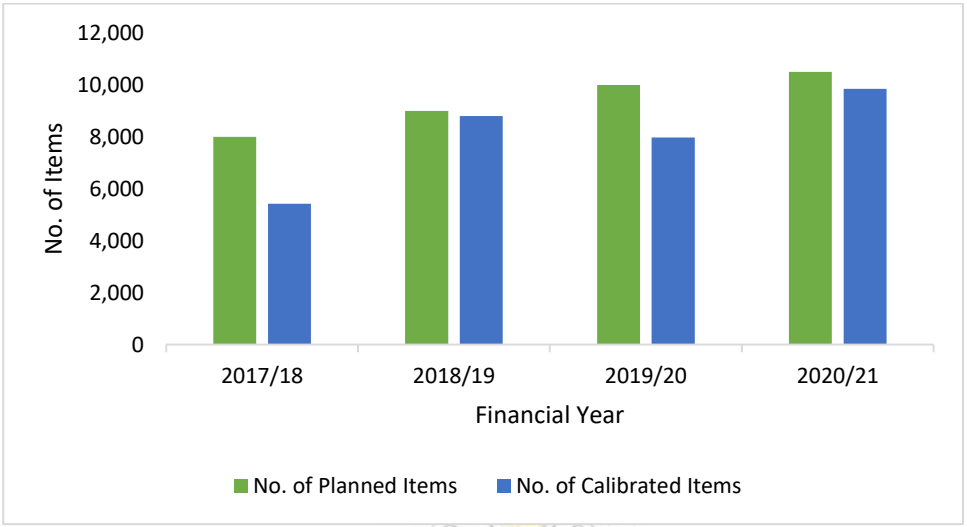
Review of the implementation reports noted that, TBS did not disseminate the information of SI-unit to laboratories and other users in the country. TBS did not adequately disseminate information to the public about metrology issues.

Based on interviews on this deficiency, it was noted that TBS only depended on metrological day (20th May of each year) to disseminate this information. This is because depending only on this day did not cover many users and the general population.

6.7 Inadequate Implementation of Scientific and Industrial Metrological Control Activities

TBS planned to calibrate 45,000 industrial items through Metrology Laboratory Section for the period of 2016/17-2020/21. However, they managed to calibrate 37,820. **Figure 6.2** presents the trend of calibration in specific financial years.

Figure 6.2: The Trend of Calibration in Financial Years from 2017/18 to 2020/21



Source: *Auditor's Analysis Based on Review of the Plan and Implementation Reports*

Based on **Figure 6.2,** TBS through its Metrology Laboratory did not manage to achieve their annual planned targets during implementation throughout the entire audit period. Interviews with TBS, Metrology Laboratory Section officials noted that, having little number of working standards for calibration, it has been difficult for technical personnel to divide into different groups for conducting calibration services to different customers.

In addition, based on interviews with TBS officials the scientific metrology was not conducted, and TBS has been relying on the results from other scientific researches done by other Higher learning and learning research institutions to get the picture and information related to state of scientific metrology. However, TBS have its own research department which did not conduct researches on metrological subject. It was later known that, these deficiencies were connected to lack of planning and commitment by TBS in

conducting scientific metrology. There was no known established financing mechanism for these activities.

6.8 Delay in Calibration of the Industrial Metrological Measuring Equipment

The Audit team assessed the delay based on the metrological performance on calibration of the industrial metrological items. The results have shown that the implementation of calibration of the industrial metrological measuring equipment was delayed comparing with the planned milestones as detailed in standard charter. The Standard charter required that, calibration of the industrial metrological items to take not more than five days from the day of payment. Moreover, the issuance of certificates required to take not more than 14 days after payment. **Table 6.4** shows the extent of delays for each activity and more details are shown in ***Appendix 16***.

Table 6.4: Delays in Calibration of Industrial Items for Financial Year 2020/21

Range of delays (Days)	Number of companies delayed for Calibration	Number of companies (customer) -delayed of issued Certificates
0- 20	124	77
20- 40	56	13
40-60	20	7
60-80	6	1
80-100	4	0
100-150	5	1
150 and above	7	3

Source: *Auditors' Analysis of the Performance Reports of the Industrial Metrological Items of 2020/21*

From **Table 6.4** It can be seen that, majority of delay in both conducting calibration and issuance of certificates was between 0-20 days. About seven companies, experienced highest delay for calibration and three companies experienced highest delay of above 150 days before being certified. Moreover, based on the data set analysed the highest delay took 377 days for calibration and 352 for certification.

Almost all these delays were caused by inadequate capacity of working standards at TBS. Because there are few instrument conducts calibration services it creates a big workload. These as a result, allow the customer to continue offering different services without calibrated instruments. For example, the customer who waited for more than 200 days waiting for calibration of their instruments include the Water Institute, Ocean Road Cancer Institute, Air Tanzania, and the Tanzania Medicines and Medical Devices Authority (TMDA). These entities are all offering essential services in which their instruments were supposed to be fully calibrated on time.

CHAPTER SEVEN

MONITORING AND EVALUATION OF CONTROL ACTIVITIES

7.1 Introduction

This chapter presents findings regarding Monitoring and Evaluation of control activities by the Ministry of Investment, Industry and Trade (MIT). It covers monitoring and evaluation of control activities performed by WMA and TBS:

7.2 Monitoring and Evaluation of Implementation Performed by WMA and TBS

Part 3.6.2 (i), (ii), (x) of Functions and Organization Structure of the Ministry of Trade and Industry, 2019 required the ministry to monitor and evaluate implementation of its Annual Plans and Medium Term Strategic Plans; prepare periodic performance reports and monitor performance of Executive Agencies under the Ministry.

Review of performance reports[15] noted that, the Ministry managed to prepare an Annual Performance Reports. However, the review of all four report submitted to audit team or showed that, issues concerning the state and performance of metrological activities was not adequately covered. This is an indication that, the Ministry did not adequately monitor the performance of the Weights and Measures Agency (WMA) and Tanzania Bureau of Standards (TBS), on control activities about legal, scientific, and industrial metrology. Based on the interviews with responsible officials, this weakness was partly caused by lack of established monitoring system and support tools which allows assessment on metrology in the country.

[15] MIT Progress Reports

7.2.2 Inadequate Monitoring Performance of Executive Agencies under the Ministry

Review on the monitoring reports it was noted that, monitoring approach applied by the Ministry to its agencies was found not effective. This is because, based on the Annual Performance of 2020/2021, the Audit team noted that, the Ministry did not monitor its agencies based on established Key Performance Indicators (KPI) or targets. Instead, the Ministry just received the quarterly reports from its agencies (WMA and TBS) and consolidated them. There were no reports to show that the Ministry conducted evaluation to assess the performance of WMA and TBS. Moreover, it was noted that the Ministry did not verify the submitted information as part of its validation process.

According to interviews with MIT officials Audit team noted that, there were incidences where the Ministry conducted ad-hoc monitoring activities. In this case a desks affair responsible for specific agency would team-up with another officer from the monitoring and evaluation department of the Ministry and visit the agencies. However, no monitoring reports are prepared in these ad-hoc visits.

Interviews with MIT officials noted that, there was no information to show that, the agencies were given feedback regarding areas that require improvement. Consequently, the Ministry could not effectively measure and ensure the improvement level of performance of metrological activities, and asses the level of implementation of recommendations from the identified challenges.

According to interviews with officials dealing with Monitoring and Evaluation, the Ministry's budget allocated annually to carry out monitoring activities in the monitoring and evaluation department was not provided accordingly. There could be several reasons to this including unreliable

disbursement of other charges and other charges deficit to the Ministry. However, in all years covered by this audit the disbursement varied from 30% to 45%. There was no any financial year of the audit scope the budget exceeded 45%. It is because of this, the M&E activities suffered low priority in ranking.

CHAPTER EIGHT

CONCLUSIONS

8.1 Introduction

This chapter presents the audit conclusions based on the findings as presented in chapters 3, 4, 5, 6 and 7 of this report. The conclusion forms two parts namely, general, and specific conclusions as detailed below:

8.2 General Conclusion

The Audit findings lead to the conclusion that Ministry of Investment, Industry and Trade (MIT), the Weights and Measures Agency (WMA) and Tanzania Bureau of Standards (TBS) inadequately implemented control activities on legal, scientific, and industrial metrology. This is because both WMA and TBS did not adequately verify accuracy of both standards and measuring instruments and the Ministry did not adequately monitor the implementation activities of WMA and TBS to protect consumers on issues related to measurements.

8.3 Specific Conclusions

The following are specific conclusions:

8.3.1 WMA Inefficiently Managed Standards and Verification for their Accuracy (Traceability)

WMA did not verify the weight, capacity and length measuring working standards. Given the importance of these standards for the country's economy, WMA has not strategically planned to build their capacity to perform this function. Meanwhile, the Audit team noted that the approach used by WMA in which the WMA HQ went to the specified verification

Centre's in the regions to verify WMA regions' working standards was creating delaying environment which is ineffective. Moreover, WMA did not keep calibration certificate during verification of accuracy of standards.

8.3.2 Verification for Accuracy of Measuring Instruments;

WMA did not verify for accuracy the measuring instruments in health sector, safety and environment. Lack of verification in these sectors carries a huge risk to the health and safety of people as well as environment. WMA has put little priorities in these sectors, out of it limited staff resources and budget, no effort was put to ensure instruments related to health, safety and environment are verified.

8.3.3 WMA Inadequately Managed Pre-Package of Goods.

The management of pre-package, compliance of product labelling, and product quantity management at the point of packing was inadequate. WMA did not cover majority (97%) of manufacturing industries to inspect packed goods. This denies the assurance of consumers that the information on net quantities is verified.

8.3.4 WMA through Surveillance and Inspection Inadequately Ensured the Control for Compliance with Metrology Perform Well

Market surveillance and inspection did not focus on improvement of measurement control through quality assurance and guarantee fair competition to manufacturer, importers and distributors (has not served the interest of economic operator in helping to eliminate unfair competition). WMA surveillance has no computerised or web based system to supervise the performance of instruments which would minimise the amount of measuring instrument that don't meet regulatory requirements. This implies that market surveillance has not ensured the measuring instruments

available for sale and those are introduced in market meets regulatory requirements.

8.3.5 TBS had Inadequate Capacity In terms of National Measurement Standards

TBS as a National Measurement standard have no capacity to fully exercise this mandate as it lacks some key reference standard equipment. For example, TBS has no reference standards equipment for fields of radiology, sound, light, viscosity, high voltage, flow rated, frequency in aviation and air quality.

Given the importance of these equipment TBS has not allocated funds for procurement of these standards. It is because of this, TBS has been losing potential revenue as consumers would take their equipment outside the country for calibration. Furthermore, lack of this led to uncertainty of measurement to these fields.

8.3.6 TBS Adequately Acted as National Metrology Institute (NMI) and Conducted Scientific and Industrial Metrology Activities to Ensure Customers Protection

TBS inadequately conducted scientific and industrial metrology as a National Metrology Institute (NMI).This is because it did not implement the following important functions for the NMI: maintaining and developing national measurement standards according to national needs; promote the concept of traceability to the SI; disseminate the SI units to accredited laboratories, to other industrial and commercial laboratories and to other users in their country. In addition, It did not establish traceability arrangements with other NMIs or the BIPM for those units for which there are no national primary standards; ensuring traceability of the measurement standards used for verification by legal metrology authorities (WMA); maintaining a general overview of the complete national

calibration/traceability hierarchy (the National Measurement System); carrying out comparisons of its national realisations of SI units with other NMIs and participating in CIPM or RMO comparisons within the CIPM MRA (mutual recognition arrangement of national measurement standards and of calibration and measurement certificates issued by national metrology institute) framework; maintaining a quality system consistent with the requirements of the ISO/IEC 17025); appoint other designated institutes laboratories; and appoint other designated institutes laboratories.

8.3.7 Ineffectively Monitored Legal, Scientific, and Industrial Metrological Activities Performed by WMA and TBS

The Monitoring and Evaluation practise done by the MIT does not allow for effective assessment and continues improvement of the weight and measure in the country. The Ministry only do the compilation of reports from TBS and WMA without doing any assessment of performance. It was difficult to trace the progressive performance of metrology in the developed annual report. The Ministry has not developed KPIs and mode of follow-up of the implementation of WMA in the country. Given the importance of Monitoring and Evaluation, the priority in terms of allocation of fund and development of supportive tool and system has been weak.

CHAPTER NINE

RECOMMENDATIONS

9.1 Introduction

This chapter provides recommendations to the Ministry of, Investment, Industry and Trade, Weights and Measures Agency and the Tanzania Bureau of Standards to address matters noted during audit. The National Audit Office believes that on implementation of these recommendations will greatly contribute to the improvement in the implementation of control activities and hence protect consumers on issues related to measurements in the country.

9.2 Recommendations to the Audited Entities

9.2.1. Recommendations to Weights and Measure Agency

The Weights and Measures Agency should:

1. Establish comprehensive database to capture all legal control activities for both standards' performance status and patterns approval;

2. Develop office policies for supporting effective enforcement of measurement standards and develop guidelines based on European Union (EU) directives and OIML recommendations other than volume and flow measures to assist staff in planning, conducting, and reporting their operations;

3. Establish comprehensive resource needs analysis to establish gap of both secondary and working standard equipment, human resources,

vehicles, and tools needed for effective implementation of legal metrological activities;

4. Prioritize capacity building of the institution in terms of all required secondary and working standards, keeping standards in their acceptable ambient conditions of traceability of its accuracy, training programs and human resources including conducting cost and benefit analysis of temporary and permanent employees so as to enhance competence of WMA on emerging issues of metrology;

5. Prioritise risk-based and realistic targets based on reliable source in planning and implementation of existing legal and metrological measuring instruments including public and consumers' awareness so as to achieve effective consumers' protection.

9.2.2. Recommendations to Tanzania Bureau of Standards

The Tanzania Bureau of Standards should:

1. Establish comprehensive database to capture all reference standard equipment, performance status, scientific, and industrial control activities;

2. Conduct a comprehensive needs analysis to establish gaps of both reference standard equipment and human resources needed for effective implementation of country's needs; and

3. Prioritize capacity building in terms of all required reference standards, trainings and human resources to increase competence of TBS for effective performance of metrological activities as the National Metrology Institute.

9.2.3. Recommendations to the Ministry of Investment, Industry and Trades

The Ministry of Industry and Trade should:

1. Prioritize completion of National Quality Policy including establishing national accreditation body that will support accreditation of calibration and testing laboratories in the country so as to improve the quality of infrastructures of metrology in the country;

2. Develop a monitoring system and support tools such as guiding document to oversee implementation and assessment of legal, scientific, and industrial metrology in the country; and

3. Consider establishment of an independent department that would implement the functions of the National Metrology Institute in the country to enable independent supervision and monitoring of legal, scientific, and industrial metrology activities.

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8. The OIML (International Organization of Legal Metrology) D1, Edition 2004 (E)
9. The OIML document (OIML D1 Edition 2004E)
10. The OIML R 79:2015 (E);
11. The pre-package reports and report of the industrial mapping desktop survey published in August, 2021.
12. URT, The Tanzania Bureau Standard Act of 2009,
13. URT, The Weights and Measures (General) Regulations, 2019;

14. URT, The Weights and Measures ACT CAP 340, The Weights and Measures Act (Amendment) Order, 2018
15. National Institute Standard of Technology (NIST) handbook 133 of 2013
16. General Regulation of Weights and Measures of 2019

17. Importance of radiology in healthcare, Published: February 2, 2021, Written by: Department of Radiology & Diagnostics

18. The importance of measuring light by bem studio (Accessed on January, 2022)

19. https://www.google.com/search?client=firefox-b-d&q=importance+of+frquency+in+aviation (15/01/2022) (Accessed on January, 2022)

20. https://www.google.com/search?q=Importance+of+flow+rates+measurements&client (Accessed on January, 2022)

21. https://www.google.com/search?q=air+quality+measurement+importance&client (Accessed on January, 2022)

22. https://www.google.com/search?q=importance+of+high+voltages+measurements&client (Accessed on January, 2022)

23. https://www.google.com/search?q=importance+of+viscosity+in+engineering&client (Accessed on January, 2022)

24. https://www.google.com/search?q=importance+of+viscosity+in+pharmacy&client (Accessed on January, 2022)

25. https://www.google.com/search?q=importance+of+viscosity+in+industry&client (Accessed on January, 2022)

APPENDICES

Appendix 1: Responses from Audited Entities

A. Responses from the Ministry of Investment, Industry and Trade (MIT) and Weights and Measures Agency

Specific Comments

S/N	Recommendations	MIT Comments/ responses	Actions to be taken	Planned date/ Timeline
1	Prioritize completion of National Quality Policy including establishing national accreditation body that will support accreditation of calibration and testing laboratories in the country so as to improve the quality of infrastructures of metrology in the country;	The recommendation has been taken into consideration	Currently the drafting team is in Morogoro working on comments given by The Cabinet Secretariat. After completion the draft document will be resubmitted to the CS for their guidance and further actions.	June, 2023
2	Develop a monitoring system and support tools such as guiding document to oversee implementation and assessment of legal, scientific, and	The recommendation has been taken into consideration	M&E Section is in the process of preparing an integrated Strategic Plan of the Ministry of Investment, Industry and Trade by	June, 2025

S/N	Recommendations	MIT Comments/ responses	Actions to be taken	Planned date/ Timeline
	industrial metrology in the country; and		merging the former SP of Ministry of Industry and Trade with the existing Strategic Plan Draft of the former Prime Minister's Office - Investment. The completion of the integrated Strategic Plan will enable the preparation of the M&E framework to begin. NB: The frame work will incorporate monitoring system and support tools such as guiding document to oversee also implementation and assessment of legal,	

S/N	Recommendations	MIT Comments/ responses	Actions to be taken	Planned date/ Timeline
			scientific and industrial metrology in the country	
3	Consider establishment of an independent department that would implement the functions of the National Metrology Institute in the country to enable independent supervision and monitoring of legal, scientific, and industrial metrology activities.	The recommendation has been taken into consideration	After completion of the National Quality Policy which is underway, major structures will be derived from the policy document including National metrology Institute (NMI). Also The Ministry in collaboration with its Agencies will carry out study on the best way to develop NMI and prepare development implementation plan	June, 2025

B. Responses from the Weights and Measures Agency (WMA)

General Comments

We have received the five recommendations and we promise to work on them as per timeline.

Specific Comments

S/N	Recommendations	WMA Comments/ responses	Actions to be taken	Planned date/ Timeline
1	Establish comprehensive database to capture all legal control activities for both standards' performance status and patterns approval;	The audit revealed existence of database however the need for comprehensiveness is necessary.	To develop a comprehensive VIPIMO SOFTWARE	June, 2024
2	Establish comprehensive resource needs analysis to establish gap of both secondary and working standard equipment, human resources, vehicles, and tools needed for effective implementation of legal metrological activities;	Filling the gaps mentioned is a continuous process	To establish a resource needs analysis	June 2023
3	Develop office policies for	The requirements of the document are	To continue implementing	June, 2025

S/N	Recommendations	WMA Comments/ responses	Actions to be taken	Planned date/ Timeline
	supporting effective enforcement of measurement standards and develop guidelines based on European Union (EU) directives and OIML recommendations other than volume and flow measures to assist staff in planning, conducting, and reporting their operations;	reflected in WMA establishment order GN No. 194 of 2002 and in the Strategic Plan 2021/22-2025/26. On the issue of guidelines, not only volume and flow measures but also other technical test manuals are derived from international guidelines like OIML and EU directives.	the requirements of the establishment order and other Legal documents. However, WMA will continue to update technical tests manuals from time to time.	
4	Prioritize capacity building of the institution in terms of all required secondary and working standards, keeping standards in their acceptable ambient conditions of traceability of its accuracy, training programs and human resources including	Procurement of standards is achieved by identifying the required working and secondary standards through the WMA yearly procurement plan which also consider their maintenance in an acceptable ambient condition; however staff are	To set aside 11.5 b in FY 2022/23 for procurement of standards and capacity building programs.	June, 2024
			To set aside 300,000,000 in FY 2022/23 for capacity Building programs.	June, 2023

S/N	Recommendations	WMA Comments/ responses	Actions to be taken	Planned date/ Timeline
	conducting cost and benefit analysis of temporary and permanent employees so as to enhance competence of WMA on emerging issues of metrology;	developed to enhance their competence through the Agency's TNA. Still, Due to shortage of permanent staff, WMA will continue to engage temporary employee in existing and emerging areas.	WMA will conduct cost and benefit analysis on temporary employment system but also outsource some of WMA activities	December, 2022
5	Prioritise risk-based and realistic targets based on reliable source in planning and implementation of existing legal and metrological	We have realises a need to cooperate with other relevant institutions in order to set realistic target of existing legal and	To collaborate with other relevant institutions and develop VIPIMO SOFTWARE	June, 2024

S/N	Recommendations	WMA Comments/ responses	Actions to be taken	Planned date/ Timeline
	measuring instruments including public and consumers' awareness so as to achieve effective consumers' protection.	Metrological measuring instruments. However, WMA has set aside 420,000,000 for Financial Year 2022/2023 for this a as compared to 224,600,000 for Financial Year 2021/2022 equivalent to 87% increase.	However, WMA will continue to prioritize and implement plans on awareness campaigns in all matters related to weights and measure activities.	June, 2023

C. Responses from the Tanzania Bureau of Standards (TBS)

Specific Comments

S/N	Recommendations	TBS Comments/ responses	Actions to be taken	Planned date/ Timelines
1	Establish comprehensive database to capture all reference standard equipment, performance status, scientific, and industrial control activities;	Following the approval of organisational structure on 28th December 2021, the process of enactment of Metrology Regulations will be initiated. The Regulations will facilitate legal coordination with other agencies/ authorities enforcing traceability of metrological measurements.	To constitute a team for preparation of Metrology Regulations. Gathering information about database for reference standards and start establishment of Database	By December, 2022 By June 2023
2	Conduct a comprehensive needs analysis to establish gaps of both reference standard equipment and human	Needs analysis for reference standards equipment will be conducted before the end of the financial year 2022/2023. In addition, the Bureau has set	To conduct needs analysis for reference standards equipment in the financial year 2022/2023 and human	Needs analysis for reference standards equipment will be conducted before the end of the financial year 2022/2023. In addition, the Bureau has set

S/N	Recommendations	TBS Comments/ responses	Actions to be taken	Planned date/ Timelines
	resources needed for effective implementation of country's needs; and	aside funds in the financial year 2021/2022 to conduct human resources needs analysis including Metrology Section. Furthermore, the Bureau has started initial communication with PO-PSMGG to request HR experts through letter with Ref.No.BG.331/407/01C/43 dated 2021-11-22 who will join the TBS team in preparation of human resources plan (job list analysis and hr audits).	resource needs analysis in financial year 2021/2022 and follow of the requested staff from PO-PSM&GG.	aside funds in the financial year 2021/2022 to conduct human resources needs analysis including Metrology Section. Furthermore, the Bureau has started initial communication with PO-PSMGG to request HR experts through letter with Ref.No.BG.331/407/01C/43 dated 2021-11-22 who will join the TBS team in preparation of human resources plan (job list analysis and hr audits).

S/N	Recommendations	TBS Comments/ responses	Actions to be taken	Planned date/ Timelines
3	Prioritize capacity building in terms of all required reference standards, trainings and human resources to increase competence of TBS for effective performance of metrological activities as the National Metrology Institute.	The Bureau will continue to set aside funds to facilitate purchase of reference standards equipment. For instance, in the Financial Year 2021/2022 and 2022/2023 the Bureau budgeted about TZS 3.05 Billion and TZS 1.5 Billion respectively for acquisition of the aforementioned equipment The Bureau has trained one staff and other four staff to be trained in 2021/2022 budget in the area of metrology and has set aside fund in 2022/2023 for training other two staff in pressure	To set aside funds in every year for purchase of reference standards equipment. To continuing training for metrology staff. Follow up of appointment of Metrology Manager at PO-PSM&GG.	By June 2025 By June 2023 By June 2023

S/N	Recommendations	TBS Comments/ responses	Actions to be taken	Planned date/ Timelines
		and electrical metrology. The approved organization structure of 2018 has been implemented. However, the post of Metrology Manager was approved in the 150th BoD meeting held on 29th October, 2021. Hence appointment of Metrology Manager will increase the performance of metrology activities as National Metrology Institute.		

Appendix 2: Audit and Sub Audit Questions

Audit Question 1	**Does WMA efficiently manage verification for accuracy (traceability) of secondary and working standards?**
Sub-audit Question 1.1	Does WMA ensure that records of standards and their performances are documented and accessible?
Sub-Audit Question 1.2	Does WMA timely Compare Secondary Standards against National Standards?
Sub-audit Question 1.3	Does WMA adequately verify Accuracy (Traceability) of Working Standards?
Audit Question 2	**Does WMA ensure verification for accuracy of measuring instruments?**
Sub-audit Question 2.1	Does WMA adequately provide pattern approval of the measuring instruments?
Sub-Audit Question 2.2	Does WMA conducted regular review of old pattern?
Sub-audit Question 2.3	Does WMA adequately conduct re-verification of the measuring?
Sub-audit Question 2.4	Does WMA verify all metrological instruments?
Sub-audit Question 2.5	Does WMA monitor activities of calibration of the Volume and Flow Measurement Conducted by private practitioners?
Sub-audit Question 2.6	Does WMA adequately approve technical Drawings and Structures of Volume and Flow Measures?
Audit Question 3	**Does WMA adequately manage pre-package of goods?**
Sub-audit Question 3.1	Does WMA adequately make control of the labelling of the products?
Sub-audit Question 3.2	Does WMA adequately inspect goods according to available number of industries?
Sub-audit Question 3.3	Does WMA adequately manage packaging of the farm produces?
Audit Question 4	**Does WMA through surveillance and inspection ensure that the control set for compliance with metrology performs well?**
Sub-Audit Question 4.1	Does WMA have strong surveillance and reporting system?

Sub-audit Question 4.2	Does WMA adequately disseminate Awareness on Legal Metrological activities to the public?
Sub-Audit Question 4.3	Does Surveillance section undertaken comprehensive watchdogging on implementation conducted by the weight and measure offices?
Sub-Audit Question 4.4	Does WMA have adequate source of information providers?
Sub-Audit Question 4.5	Does WMA set appropriate plan related to the risk areas of inspection?
Audit Question 5	**Does TBS adequately act as National Metrology Institute (NMI) and conduct control activities on scientific and industrial metrology?**
Sub-Audit Question 5.1	To what extent does TBS assume the role of the National Metrology Institute?
Sub-Audit Question 5.2	Does TBS have adequate capacity in terms of reference standard /National measurement standards?
Sub-Audit Question 5.3	To what extent does TBS has accreditation of its laboratory?
Sub-Audit Question 5.4	Does TBS participate in inter-laboratories comparisons of all aspect of metrological instruments?
Sub-Audit Question 5.5	Does TBS provide awareness related to SI-unit to laboratories and other users in the country?
Sub-Audit Question 5.6	To what extent does TBS provide service according to the required time?
Audit Question 6	**Does the Ministry of Investment, Industry and Trade (MIT) effectively conduct Monitoring and Evaluation of metrology activities performed by TBS and WMA?**
Sub-Audit Question 6.1	Does MIT effectively monitor and evaluate implementation of WMA's objectives and targets on legal metrology?
Sub-audit Question 6.2	Does the existing human resources employment system of WMA support for an effective implementation of legal metrological Activities?

Appendix 3: List of Documents Reviewed at WMA, TBS and MIT

S/N	Document reviewed	Reason(s)
List of documents reviewed at HQ of WMA, TBS and MIT		
1.	Plans and budgets	To assess extent to which the plans and budgets considered control activities on measurements (legal, scientific, and industrial metrology)
2.	Performance reports	To assess the extent which the performance of the ministry, TBS and WMA considered the control activities on weights and measures (legal, scientific, and industrial metrology)
3.	Correspondence between MIT, WMA, and TBS	To assess the issues and extent which the ministry, TBS and WMA considered the control activities on weights and measures (legal, scientific, and industrial metrology)
4.	Monitoring reports	To examine the way MIT monitored the performance of TBS and WMA during the implementation of legal, scientific, and industrial metrological activities.
5.	WMAs Weights and Measures personnel staffing level during implementation of legal metrology in the selected WMA regions	To find out whether the capacity in term of standard equipment; human resources; and transportation facilities that were available during implementation of legal, scientific and industrial metrology activities were proportional to tasks needed to be implemented.
List of documents reviewed at WMA Regional Offices		
6	Re-verification of standards reports and certificates	To assess the extent which the working standards of the visited WMA regions were re-verified before using them for verification in the field.

S/N	Document reviewed	Reason(s)
7	Operational Plans	To assess the extent to which the visited WMA regions planned for metrological activities
8	Implementation Reports (verifications and inspections)	To assess and establish the extent which the metrological activities were implemented in the visited WMA regions.
9	File of facilitation, issuance, and renewal of licenses to practitioners of legal metrology	To assess the way facilitation, issuance, and renewal of licenses to practitioners of Legal Metrology was conducted
10	File of Awareness Education to the public	To assess the way and extent education activities on current and potential customers on awareness on legal metrology issues were conducted
11	File of professional conduct to legal metrology practitioners	To examine the way professional conduct of legal metrology practitioners is controlled

Source: *Auditors' Analysis*

Appendix 4: List of Persons Interviewed and Reason(s)

S/N	Person(s) Interviewed	Reason(s)
1.	Director responsible for Metrology issues at MIT	To know the extent which MIT monitored legal Metrology activities
2.	Commissioner responsible for Legal, scientific and industrial Metrology Policy Division at MIT	To know the extent to which the MIT's formulated policy considers the legal metrology activities.
3.	Manager of Human Resources Section at WMA HQ	To know the extent of effort done by WMA to request employment permission of Weights and Measures Officials
4.	Manager of Human Resources Section at TBS HQ	To know the extent of effort done by TBS to ensure availability of needed manpower to conduct enforcement
5.	Manager of Communication and Public Relations Section	To assess the extent to which WMA conducted awareness education to the public on issues related to weights and measures
		To assess the way on which WMA handles customers' complaints related to weights and measures
6.	Director responsible for Technical Services at WMA HQ	To assess the way on which Technical Services Directorate oversee metrological activities of other Sections and its performance reporting mechanism
7.	Manager of Standards and Verification Section	To know the extent to which WMA HQ conduct verification of standards to the National Measurement Standards to ensure effective traceability of working and commercial standards
8.	Head of Metrology Laboratory at TBS	To know the extent which TBS HQ conducts traceability, developing and maintaining of National measurement standards to ensure compliance to requirements

S/N	Person(s) Interviewed	Reason(s)
9.	Manager of Surveillance Section Verification	To assess the extent which Surveillance Section scrutinizes, analyses and compiles reports of WMA regional offices and give advice.
10.	Manager of Volume and Flow Measurements Section	To assess the extent which WMA calibrates, verifies, and inspects volume and flow measuring instruments.
11.	Regional Managers of WMA offices sampled to be visited	To assess the extent which WMA calibrates, verifies, and inspects all measuring instruments in their areas of jurisdiction.

Source: *Auditors' Analysis*

Appendix 5: Weights and Measures Instruments

Weight Measuring Instruments	
	
Photo 1: Counter scale (C/S)	**Photo 2:** Platform Scale (P/S)
	
Photo 3: Weighing Spring balance (S/B)	**Photo 4:** Spring balance (S/B)

Photo 5: Weighbridge (W/b)

Photo 6: Axle Weigher (Ax/W)

Photo 7: Automatic Filler (Au/F)

Photo 8: Beam Scale (B/S)

Capacity Measuring Instruments	
	
Photo 9: Bulk Storage Tank (BST)	**Photo 10:** Fixed Storage Tank (FST)
	
Photo 11: Sand and other Ballast (SBL)	**Photo 12:** Weights (WGT)

Photo 13: Flow meter (F/M)

Photo 14: Fuel Pump (FP)

Photo 15: Check pump (Ch/p)

Photo 16: Vehicle Tank (VTC)

Length Measuring Instruments	
	 
Photo 17: Metre rule (MR)	**Photo 18:** Tape Measure (TM)
	
Photo 19: Dip Tape	**Photo 20:** Dip Stick

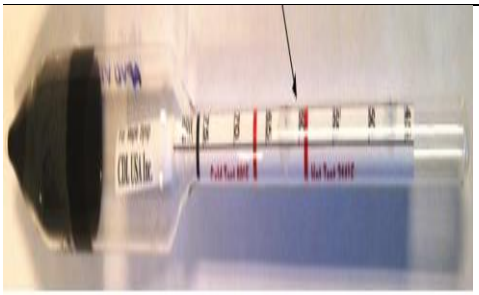	
Photo 21: Hydrometer	**Photo 22:** UTI measuring instrument

***Source**: Photos Taken by the Auditors During Site Visits, July 2021*

Appendix 6: Unit Measurements by OIML R 79:2015 (E)

UNITS	SYMBOLS
Milligram	mg
Gram	g
Kilogram	kg
Tonne	t
Millilitre	mL or ml
Centilitre	cL or cl
Litre	L or l
Micrometre	µm
Millimetre	mm
Centimetre	cm
Metre	m
square millimetre	mm^2
square centimetre	cm^2
square decimetre	dm^2
square metre	m^2
cubic centimetre	cm^3
cubic decimetre	dm^3
cubic metre	m^3

a. Neither a period nor the letter "s" should be used after any of the symbols.

b. The alternative symbol for the litre, L, was adopted by the general conference of weights and Measures (CGPM) in order to avoid the risk of confusion of the letter l and number 1.

Source: *Auditor's Review of the OIML R 79:2015 (E).*

Appendix 7: Main Summary of Industrial Establishment Based on Subsector Across Regions and Zones of Tanzania Mainland

Zone Name	Region name	Manufacturing	Mining and quarrying	Water supply, sewage, waste management and remediation	Electricity, gas, steam and air conditioning supply	Total	Percentage (%)
Central	Dodoma	2806	6	58	26	2896	3.6
	Singida	2534	60	17	8	2619	3.2
	Tabora	1614	17	6	9	1646	2
Subtotal Central		6954	83	81	43	7161	8.8
Eastern zone	Dar es salaam	14519	84	147	63	14813	18.3
	Morogoro	4495	9	23	63	4590	5.7
	Pwani	2584	54	20	30	2688	3.3
Subtotal eastern		21598	147	190	156	22091	27.3
Lake zone	Geita	1470	43	4	0	1517	1.9
	Kagera	3351	33	9	1	3394	4.2
	Mara	4843	167	10	0	5020	6.2
	Mwanza	2708	13	17	4	2742	3.4
	Shinyanga	1932	58	29	0	2019	2.5
	Simiyu	933	4	17	0	954	1.2
Subtotal lake		15237	318	86	5	15646	19.3
Northern	Arusha	2860	46	13	16	2935	3.6
	Kilimanjaro	2699	60	41	39	2839	3.5

Zone Name	Region name	Manufacturing	Mining and quarrying	Water supply, sewage, waste management and remediation	Electricity, gas, steam and air conditioning supply	Total	Percentage (%)
	Manyara	3739	592	23	8	4362	5.4
	Tanga	2580	28	19	22	2649	3.3
Subtotal Northern		11878	726	96	85	12785	15.8
Southern Highlands	Iringa	4063	22	9	34	4128	5.1
	Mbeya	4360	45	27	37	4469	5.5
	Njombe	2922	3	6	19	2950	3.6
	Songwe	104	3	6	1	114	0.1
Subtotal southern highlands		11449	73	48	91	11661	14.4
Southern	Lindi	964	41	13	15	1033	1.3
	Mtwara	1423	33	9	7	1472	1.8
	Ruvuma	3931	4	9	6	3950	4.9
Subtotal southern		6318	78	31	28	6455	8
Western	Katavi	646	7	2	8	663	0.8
	Kigoma	2271	5	13	16	2305	2.8
	Rukwa	2180	9	6	7	2202	2.7
Subtotal western		5097	21	21	31	5170	6.4
Total (All zones)		78531	1446	553	439	80969	100
Percentage (%) (All zones)		97	1.8	0.7	0.5	100	

Source: *Report of the Industrial Mapping Desktop Survey Published by MIT in August, 2021*

Appendix 8: Main Summary of Industrial Establishment Based on Size Across Regions and Zones of Tanzania Mainland

Zone Name	Region name	Large	Medium	Small	Micro	Total	Percentage (%)
Central	Dodoma	8	10	600	2278	2896	3.58
	Singida	6	12	472	2129	2619	3.23
	Tabora	8	10	190	1438	1646	2.03
Subtotal Central		**22**	**32**	**1262**	**5845**	**7161**	**8.84**
Eastern zone	Dar es salaam	208	224	4485	9896	14813	18.29
	Morogoro	39	19	820	3712	4590	5.67
	Pwani	42	31	678	1937	2688	3.32
Subtotal eastern		**289**	**274**	**5983**	**15545**	**22091**	**27.28**
Lake zone	Geita	1	2	141	1373	1517	1.87
	Kagera	9	5	468	2912	3394	4.19
	Mara	19	13	813	4175	5020	6.2
	Mwanza	18	18	764	1942	2742	3.39
	Shinyanga	16	36	962	1005	2019	2.49
	Simiyu	0	0	158	796	954	1.18
Subtotal lake		**63**	**74**	**3306**	**12203**	**15646**	**19.32**
Northern	Arusha	55	51	874	1955	2935	3.62
	Kilimanjaro	27	37	687	2088	2839	3.51
	Manyara	48	73	953	3288	4362	5.39
	Tanga	43	39	494	2073	2649	3.27
Subtotal Northern		**173**	**200**	**3008**	**9404**	**12785**	**15.79**
Southern Highlands	Iringa	18	28	787	3295	4128	5.1
	Mbeya	23	25	1056	3365	4469	5.52
	Njombe	4	7	603	2336	2950	3.64

Zone Name	Region name	Large	Medium	Small	Micro	Total	Percentage (%)
	Songwe	3	4	53	54	114	0.14
Subtotal southern highlands		**48**	**64**	**2499**	**9050**	**11661**	**14.4**
Southern	Lindi	13	7	193	820	1033	1.28
	Mtwara	7	8	222	1235	1472	1.82
	Ruvuma	0	7	155	3788	3950	4.88
Subtotal southern		**20**	**22**	**570**	**5843**	**6455**	**7.97**
Western	Katavi	2	13	117	531	663	0.82
	Kigoma	0	3	319	1983	2305	2.85
	Rukwa	1	2	203	1996	2202	2.72
Subtotal western		**3**	**18**	**639**	**4510**	**5170**	**6.39**
Total (All zones)		618	684	17267	62400	80969	100.0%
Percentage (%) (All zones)		0.8	0.8	21.33	77.1	100.0	

Source: *Report of the Industrial Mapping Desktop Survey Published by MIT in August, 2021*

Appendix 9: Calculation of the Estimated Fees per One factory and the Potential Revenues Losses

(i) Calculation of the Estimated Revenue per One Factory at Ilala Territory

- The fee charged for inspection of pre-packed goods in one industry for some selected regions of high and low collection revenues as per WMA trends are listed hereunder;

    - ❖ Tabora: 83,451.09/= (lowest)
    - ❖ Kinondoni: 966,572.58/=
    - ❖ Mtwara: 1,702,609.37/=
    - ❖ Ilala: 4,922,994.23/= (highest)

(ii) Calculation of the Unverified Factories (Industries) in the Visited Regions

- Total available factories in Tanzania according to MIT = 30,933
- Total verified factories by WMA from 2017-2021 = 856
- Unverified factories (30,933 – 856) = 30,077

(iii) Calculation of the Potential Estimated WMA Losses due to the 30,077 Unverified Factories

- Lowest potential loss = 83,451.09 * 30,077=2,509,958,433.93
- Highest potential loss = 4,922,994.23 * 30,077=148,068,897,455.71