

Laboratory Capacity Building and Skills Development for a newly established Road Research Centre

Eng. Vincent Lwanda¹, Joseline Kagombora², Eng. Abdul Digaga³, Eng. Dr. Fikiri F. Magafu⁴, Dr. Martin B. Mgangira, Pr. Eng⁵

¹TARURA Materials Laboratory, P.O Box 11042, Dodoma,
Tel: +255 789 615 100 Email: vilwac@gmail.com

²TARURA Materials Laboratory, P.O Box 11042, Dodoma,
Tel: +255 753429534 Email: joseline.kagombora@tarura.go.tz

³TARURA Directorate of Rural Roads, P.O Box 11042, Dodoma,
Tel: +255 784488897 Email: abdul.digaga@tarura.go.tz

⁴President's Office, Regional Administration and Local Government
Department of Infrastructure Development, P.O.Box 1923, Dodoma,
Tel: +255 756494079 Email: fikiri.magafu@tamisemi.go.tz

⁵CSIR Built Environment, P O Box 395, Pretoria, 0001.
Tel.: +27 (12)-841-4499 Email: Mmgangira@csir.co.za

ABSTRACT:

Africa Community Access Partnership (AfCAP) is supporting research activities in Africa region. One of the projects supported by AfCAP in research activities was to build capacity and implement a laboratory skills development programme for laboratories of the Local Government Infrastructure and Transportation Research Centre (LoGITReC) in Tanzania. Laboratory capacity building efforts included human resources development, establishment of laboratory quality assurance procedures, basic laboratory work inventory system and equipment procurement. Development of general operational protocols which would provide guidance for the everyday general technical administration of the laboratory. The capacitation of the laboratory was aimed at providing capability to support the execution of the research programme. Staff at the LoGITReC laboratory and three other regional laboratories were the beneficiaries of the capacity building project.

The paper highlights experiences as expressed by LoGITReC (the beneficiaries) on the capacity building programme. A positive contribution to skills development is evident and as a result of the establishment of the laboratories, increased access to testing facilities for materials used in rural road works in Tanzania has been realised.

Key words: Human resources development, quality assurance procedures, operational protocols, laboratory quality management, and laboratory process control.

Introduction.

President's Office, Regional Administration and Local Government (PO-RALG) formulated a five year strategic plan for research development on rural roads in 2015[1, 2], whereby Capacity Building to Local Government Infrastructure and Transportation Research Centre (LoGITReC) was one among other activities, identified in order to achieve the objective of improved rural roads, with the ultimate goal of having rural roads that are passable throughout the year.

The Local Government Infrastructure and Transportation Research Centre (LoGITReC), now under Tanzania Rural and Urban Roads Agency (TARURA) [3], is implementing the strategic plan with the support from AfCAP, whereby capacity building in terms of human resources development and institutional development in the form of laboratory facilities improvement by purchasing equipment have shown great impact in the country.

Context

There are, about 122,092.98 km of District, Urban and Feeder Road networks in Tanzania. These roads are very essential as they provide communities with access to health, education and other essential services as well as links between rural areas and the main road network. The District, Urban and Feeder Road network is under the responsibility of local Government, under the President's Office, Regional Administration and Local Government (PO-RALG) and being managed by TARURA since 2017. The need for intervention in the management of District, Urban and Feeder Road network demands that TARURA has the capacity in terms of personnel with the appropriate skills and knowledge as well as facilities for material testing.

As such, there are a number of initiatives that have been undertaken to build the required capacity within LoGITReC. AfCAP, Roads Fund Board (RFB), PO - RALG and World Bank at different stages have supported LoGITReC to purchase not only major laboratory equipment at Central Material Research Laboratory (CMRL) and 9 other laboratories at Council level, but also the purchase of 107 gravel testing kits. 105 out of 184 Councils are using the gravel testing kits for quality control of road maintenance activities. In 2015, Tanzania had zero Laboratory for rural roads soil and aggregates testing services and only few Councils (about 0.5%) were able to access soil and aggregate testing facilities through Tanzania National Roads Agency (TANROADS).

AfCAP, RFB, TARURA and PO-RALG have also supported the implementation of Capacity Building through skills development of human resources and in terms of establishment of Laboratory management system to ensure the delivery of credible laboratory test results, establishing quality assurance procedures, Basic Laboratory Work Inventory System and development of general operational protocols.

As a result of the support, there is currently an increase in access to soil and aggregates testing facilities for rural roads projects whereby 52 projects have consistently been accessed by LoGITReC laboratory as compared to no project that was attended to, before establishment of LoGITReC in 2015

Furthermore, there is also an increase in the improvement of road surface condition. Tables 1 and 2 show the improvement in the road network, for roads having good and fair category from 56% in 2016 to 65% in 2018 due to improvement in the quality assurance procedures and development of human resources.

Table 1: Road condition 2016

Road Type	Road Condition (Km)			Total (Km)
	Good	Fair	Poor	
Paved	1,026.27	283.37	139.91	1,449.55
Gravel	9,732.45	9,597.37	5,075.58	24,405.4
Earth	13,853.49	27,374.52	41,863.23	83,091.24
Total	24,612.21	37,255.26	47,078.72	108,946.19
Percentage (%)	22.51%	34.21%	43.28%	100.0%

Table 2: Road condition 2018

Road Type	Road Condition (Km)			Total (Km)
	Good	Fair	Poor	
Paved	1,605.44	599.28	297.87	2,502.59
Gravel	12,091.05	11,923.24	6,305.62	30,319.91
Earth	14,883.73	29,410.28	44,976.47	89,270.48
Total	28,580.22	41,932.80	51,579.96	122,092.98
Percentage (%)	23.41%	34.34%	42.25%	100.00%

Having competent laboratory staff, the availability of laboratory equipment, proper laboratory work inventory system, user friendly quality assurance procedures and general operation protocols and quality control testing facilities, has contributed to the increase of both access and percentage of rural roads having good and fair surface conditions. It has been possible to manage the process of road maintenance in a systematic way and improved frequency of testing of more materials.

Laboratory Equipment.

Tanzania invested heavily in the purchase of Laboratory equipment for research and quality control of rural roads during the implementation of Research Projects that are mainly funded by AfCAP and Road Fund Board.

Investment was made to establish a total of 10 Laboratories. One referral laboratory established in Dodoma for research and quality control known as Central Material Research Laboratory (CMRL) and 9 other laboratories in Arusha City Council, Dodoma Municipal Council, Mwanza City Council, Mbeya City Council, Ilala Municipal Council, Kinondoni Municipal Council, Tanga City council, Mtwara Municipal council, and Temeke Municipal Council.

The Central Material Research Laboratory of LoGITReC is well equipped to handle all research and quality control testing of soil and aggregates. The plan is to get more major equipment so that the laboratory can confidently carry out bituminous materials testing and geotechnical surveys.

To safeguard the investment done in the purchase of equipment, a skills development programme was undertaken, related to the importance of proper management of laboratory equipment, inclusive of maintenance and calibration requirements that cannot be emphasised enough as it will affect the validity and quality of results. LoGITReC personnel were equipped and guided to provide proper calibration, verification and checks to ensure functionality of equipment.

The benefit of purchasing laboratory equipment and skill development on proper management of equipment has not only increased access to quality control services but also developed required highly trained personnel with skills in ensuring that the appropriate equipment is procured, verified and installed to enable CMRL function properly and provide laboratory and field testing in support of the research agenda of LoGITReC as well as provide services to other government departments, road authorities and the private sector.

Recruitment of Staff

Recruitment of staff for the research centre was done through transfer of selected council staff under works department to PO-RALG. During the training period, the centre had 8 staff including Head of the centre who was also a researcher, a laboratory manager, 5 field technicians and a driver. Of all these staff, only head of the centre and driver had enough knowledge of their duties while laboratory manager an engineer and the technicians as road technicians were completely new to their duties.

Training of Laboratory staff

Training of laboratory staff was done in two stages; training conducted at TANROADS – Dodoma region and the Training at TANROADS – CML. The training at TANROADS - Dodoma was unstructured form of training which aimed at providing introduction to technicians on practical preliminary materials testing

according to Tanzania Materials Testing Manual (2000) [4]. The later which is the base for this paper was prepared by TANROADS-CML senior staff with intimate knowledge of testing procedures detailed in the CML Laboratory Testing Manual (2000)⁴ of Tanzania. However, the complete and individual hands-on training was scheduled to be conducted at CMRL in Dodoma.

One key expected outcome of the project was well trained laboratory staff capable of carrying out the various test methods and having an understanding of the meaning of the obtained results. Phase 1 of the training was designed to be delivered through three components in order to facilitate: (i) knowledge building on fundamental principles, (ii) an understanding of the application of the tests and (iii) development of laboratory skills. Table 1 presents the objectives of the training components.

Table 3: Components of training [5]

Training Components	Description	Objective
Basic Principles	Test Objective	Provide background on test method and clarify terms
	Test equipment	Familiarise the participants with the required equipment for the test
	Test procedures	Explain to participants methods of testing
	Test application	Explain to participants to understand application of the test to practical problems
Practical Exercise	Materials testing	Familiarise participants with sample preparation for specific test method and analysis
		Provide the participants the opportunity to demonstrate ability to conduct test
		Allow participants to demonstrate individually or as a team understanding to record data
Synthesise	Synthesise knowledge acquired	Assess level of achieved understanding and areas of improvement
		Discuss lessons learnt
		Provide participants the insight into the linkage to specification requirements, materials design.

Secondment of Research Laboratory staff

The CMRL Manager was seconded to an ISO 17025 accredited research laboratory at CSIR Built Environment Advanced Materials Testing Laboratories. The secondment was aimed at providing a learning experience to the CMRL Manager for a period of three weeks, which included job shadowing the Manager of CSIR Built Environment Advanced Materials Testing Laboratories.

The secondment was intended to provide the CMRL Manager the insight into the operational and managerial requirements of a testing laboratory, both as a referral and a research laboratory, and therefore the knowledge and skills needed to implement best laboratory practices at CMRL.

The CMRL Manager observed and participated in certain aspects of laboratory safety, service delivery, for example, sample routing, laboratory testing and standardisation, which included operational procedures and equipment evaluation, discussions on both managerial and technical aspects of a research laboratory, proficiency schemes and required procedures, to have an insight into different

testing procedures. Observed testing included the standard granular materials tests, binder testing and asphalt tests.

Laboratory work Management systems.

A Software called “LoGITReC Lab Work Management System” has been developed for CMRL to effectively and efficiently process laboratory material records. It is an electronic job and materials management system for the administration of incoming work and the samples related to the work. The progress of jobs through the laboratory will be tracked using the system. The framework in form of a flow chart is provided, which helps in decision making process from sample acceptance scheduling, sample preparation, testing and recording of results, storage; and procedures for (internal and external) calibration of laboratory equipment; maintenance of the work space and laboratory equipment; and storage and filing of completed work documents.

Currently the system is only accessible to CMRL personnel, although the ultimate goal is to provide access to all Regional Materials Laboratories (RML), according to the structure of the recently established TARURA. An institutional problem has yet to be resolved. CMRL is physically situated in a separate building from the PO-RALG Headquarters and is not connected to the main server.

Performance of technician after capacity building

The CMRL is now known to all stakeholders dealing with roads under jurisdiction of TARURA. Most councils confidently use the facility for soil investigation during design of their roads. Credibility of test results, proper use of laboratory equipment, effectiveness and preparedness of technicians is the major reason for stakeholder’s sureness in the services provided by the laboratory which is the result of the capacity building offered them.

A recent visit to Mwanza region by one of TARURA financial auditors revealed collections of funds made through testing services obtainable at their laboratory. This laboratory is supervised by a technician who benefited from the capacity building program.

Challenges during and after capacity building

Time

It was learnt during the training that most tests are time bound. In spite of being well-coordinated and very interesting to participants, meeting actual time requirements for some tests was a challenge. Sometimes, overlapping of activities in trying to catch-up with time, confused participants with regard to tests continuity and smooth follow-up. However, this challenge has been solved through experience gained as real testing works are carried out.

Lack of real situation site visits for trainees

Training for laboratory testing is generally an indoor activity. However, as many of the tests conducted portray a real situation at site, visits to site whenever possible could be incorporated in the training to impart the intended understanding especially for research related tests. This is a challenge observed by the participants during the training.

Insufficient laboratory equipment

Technicians were exposed to different types of laboratory equipment during the training. As young as it is, CMRL still needs to continue investing in the purchase of laboratory equipment so that knowledge acquired during training is fully utilized by performing all tests demonstrated to them. Due to lack of some equipment, some of tests cannot be performed with all the knowledge technicians have on the tests. Tests such as shear box, Los Angeles Abrasion and pH are not done as a result of lack of equipment. Heavy investment is needed to tackle this challenge.

Increasing workload

Workload to laboratory staff is increasing mainly due to two reasons; increasing testing requirement from stakeholders and decrease in number of staff. From the confidence customers have with the laboratory, more requests for testing are made thus calling for more labour.

Conclusion.

Meeting the overall goal of TARURA to have all roads passable throughout a year can be realized through research and quality control.

Research on various surfacing type have resulted on use of local available materials like cobble stones to improve rural roads surface conditions.

As a result of the programme, laboratory services provided have assisted many Council Managers to understand materials properties during design stage and quality control during construction stage. There is a remarkable change in the quality of rural roads constructed after establishment of LoGITReC as compare to previous period.

The confidence of stakeholders in the use laboratory services of LoGITReC has increased due to skills and integrity of Laboratory personnel resulting from capacity building.

The impact of the capacity building programme, supported by AfCAP through the Technical Assistance and Roads Fund Board of Tanzania is improved connectivity of many people in rural areas through provision of better maintained rural roads with good surface condition by assuring the quality of materials used.

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