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## ESTABLISHMENT OF A NEW ANALYTICAL LABORATORY AT A FOOD PRODUCTION FACILITY IN DEKEMHARE CITY, ERITREA

June 2020

SDGs:



Countries:

Eritrea

Project Codes:

TCP/ERI/3609

FAO Contribution

USD 319 000

Duration:

1 November 2017 – 31 December 2019

Contact Info:

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### Implementing Partners

Ministry of Agriculture.

### Beneficiaries

Ministry of Agriculture Regulatory Services Department; Ministry of Health; Department of Health Services; Ministry of Trade and Industry; Eritrean Standards Institution; the private-sector food industry and consumers.

### Country Programming Framework (CPF) Outputs

Government priority 2: Food and Nutrition Security and Food Safety.

Outcome 6: By 2021 smallholder households have improved access to, and utilisation of quality food and enhanced livelihood opportunities. Output 2.2: Public sector institutions are supported to improve their capacity to provide gender responsive public services related to plant and animal health, food safety and quality.



## BACKGROUND

Food safety and quality are essential for food security, public health and economic development. Improving laboratory-testing capacity contributes to increasing the supply of safe, wholesome high-quality food by reducing the impact of food-borne diseases that can cause illness and death. Food quality analysis and management also help to stem the economic consequences of food-borne illness and food insecurity, contributing to a healthier, more prosperous and productive nation. Ensuring the safety and quality of foods also promotes international trade and access to new markets, which provides a means to strengthen livelihoods all along the value chain, alleviating poverty and hunger.

Eritrea is a young East African country, gaining independence in May 1991 after a 30-year war with Ethiopia. The development of industry in Eritrea, including the food industry and laboratories, dates back to the Italian colonial period (1890-1941), when Eritrea had a relatively prosperous economy. However, during British rule (1941-1952) and the Ethiopian administration that followed, a lack of investment led to a deterioration of its infrastructure. Eritrea's current industrial base is made up of numerous small- and medium-sized enterprises, and the Government is making a significant effort to increase their contribution to the national economy – including private-sector food production and processing enterprises.

However, Eritrea's Government is facing several macro-economic challenges, which are affecting the operations of various ministries including Ministry of Agriculture and Ministry of Health. As a result, preventive activities such as those related to food safety receive less priority than curative medical services. This has seriously affected the ministries' operation and monitoring of food safety analysis. The national food control system needs an urgent review and redesign. Establishment of basic operational and management systems, including training and capacity building of laboratory staff and laboratory accreditation to international standards, are needed to strengthen this system and enhance its capacity for ensuring that safe and nutritious food reaches consumers.

Fisheries and agriculture are important economic sectors that have good potential for producing export earnings with relatively low levels of investment. However, ever-increasing international food safety standards and trade regulations are seriously hampering the export of agricultural products and hence the country's efforts to gain market access.

In addition to agricultural products produced within Eritrea, all foodstuffs imported into the country by air, sea or land must be inspected for quality and safety according to the National Quarantine Policy and Guidelines set by the Ministry of Health. If found damaged or of insufficient quality for human consumption, these commodities must be confiscated and destroyed. However, prior to this project, the country lacked the laboratory capacity to conduct the analysis required for upholding national standards of quality and safety for human consumption.

At the same time, food security and nutrition are serious concerns in Eritrea: nearly one in every three children under five is chronically malnourished. Applying global standards, 45 percent of all deaths of children under the age of five are attributed to nutritional deficiencies. A significant proportion of the population is chronically food insecure. This has been exacerbated by persistent droughts and unpredictable rainfall patterns.

In July 2014, Eritrea's Government requested FAO's assistance in building capacity for the establishment of a small analytical laboratory in Dekemhare City dedicated to analysis for the safe production of nutritious foods. Based on this request, the laboratory was designated as responsible for testing and certifying packaged food processed from local food sources, including chickpea, groundnuts, wheat and ales.

In order to function properly, the laboratory needed modern equipment, materials and supplies. It's functioning also required government support, including adequate regulatory frameworks; heightened institutional, technical and human resource capacities; and greater awareness about the importance of testing and quality assurance among stakeholders.

This project was designed to fill these gaps by: providing necessary technologies and equipment; initiating the process of accreditation and certification; training laboratory staff in quality assurance and food safety; and raising awareness among the public and other stakeholders about the importance of laboratory analysis for good nutrition and food security.



## IMPACT

In support of government priorities and SDG 2, this project focused on improving the Government's capacity to analyse food safety and quality by providing needed laboratory equipment and supplies. To sustain these gains, the inputs were accompanied by capacity building of laboratory staff in the use of the equipment for quality assurance. These actions brought together different government actors, enhancing Eritrea's institutional framework for food safety and quality, and creating an enabling environment for food value chains based on the production of high-quality, nutritious foods.

Establishment of the food-analysis laboratory employed a participatory approach involving the Ministries of Agriculture, Health, Trade and Industry as well as the Eritrean Standards Institute (ESI). Project activities involved government stakeholders from the start in order to promote inter-institutional collaboration on safe food analysis and safe management practices. The project also envisioned collaboration with other government agencies, including those for meteorology, laboratory improvement, support to industry and marine resources. Their contribution was essential towards improving the quality and quantity of food-safety interventions in a sustainable manner. The National Animal and Plant Health Laboratory (NAPHL) and ESI worked closely through the project in areas such as training on analysis of food hazards and instrument handling (NAPHL also trained two Dekemhare City Laboratory staff). Further collaboration to facilitate food safety and quality testing is ongoing. To ensure ownership of the outputs and the sustainability of outcomes, representatives from these bodies were involved in analysing issues and deciding collectively on the solutions.

The project included an innovative component on increasing demand for safe and healthy food throughout the supply chain by increasing stakeholder awareness of food safety and quality. The Ministry of Agriculture (through NAPHL), ESI, the Ministry of Marine Resources and the Ministry of Health are now committed to advancing food safety and quality testing, and increasing awareness. The Food Security and Nutrition Steering Committee, chaired by the Ministry of Agriculture, now plans to establish a National Food Safety Laboratory and build capacity on food safety and quality. In partnership with FAO and the International Atomic Energy Agency (IAEA), ESI and collaborating institutions are also implementing a two- year food safety project (2020-2021) aimed at enhancing awareness of food safety. Such awareness sustains the gains from building capacity by broadening the market for quality nutritious foods.

## ACHIEVEMENT OF RESULTS

At the start of implementation, the national project coordinator established the project task force and national project steering committee. Establishment of an analytical laboratory to support the production of nutritious foods in Dekemhare City was initially foreseen. However, following project startup, ownership of the manufacturing plant in which the laboratory was to be established was transferred to another government organization because it was not properly functioning. As a result, the National Food Security and Nutrition Steering Committee decided to place the laboratory equipment at NAPHL, a well-established laboratory with sufficient infrastructure. In the future, the Government plans to use the laboratory equipment in the national safety laboratory that it plans to establish. The equipment delivered and installed at NAPHL included a microplate/enzyme linked immunosorbant assay (ELISA) reader, a steam distillation system and a class II Biosafety cabinet.

Laboratory infrastructure at NAPHL was strengthened by the procurement and installation of four sets of equipment, including an ultra-high performance liquid chromatography with diode array and fluorescent detectors (UHPLC-DAD/FLD). The delivery of these inputs was supported by training for laboratory staff in UHPLC-DAD/FLD, use of the microplate/ELISA reader, steam distillation system and biosafety cabinet. In addition, five other training sessions associated with instrument installation and use were implemented in the country.

These training events included staff from NAPHL and other institutions such as ESI, Dekemhare City Laboratory, the Ministries of Agriculture, Health, Trade and Industry, and DMK Manufacturing Laboratory - strengthening capacity and institutional coordination throughout the Country. In addition, two Dekemhare City Laboratory staff were trained at ESI for two weeks in preparation for additional training in analytical chemistry and food microbiology at an accredited laboratory in Uganda, along with analysts from NAPHL and ESI. Five other training sessions associated with instrument installation and use were implemented in-country.

In addition to the laboratory equipment, a range of other important laboratory supplies and chemical agents were also supplied to NAPHL through the project to support the testing of chemical and microbial food hazards.

## IMPLEMENTATION OF WORK PLAN

Soon after project startup, the planned laboratory site at Dekemhare City was changed as a result of a reorganization with the Government, which placed this site under the management of a different ministry. While this change initially stalled project activities, a decision was made to deliver the equipment and materials to a previously established laboratory with essential lab infrastructure at NAPHL. However, delivery and related capacity-building activities were delayed. In addition, the prices of the laboratory equipment were significantly higher than estimated. This caused funding constraints since most of the budget had already been used to procure the equipment. As a result, activities were not implemented within the planned budget.

International procurement of laboratory equipment and materials took much longer than expected. Since the equipment and materials ordered were very sophisticated, the specifications and bid offer were very complex and took a long time to finalize. Once the bid was finalized and contractor selected, the shipment arrangements were extremely time consuming. These delays were lengthened by the change in delivery laboratory after project startup. While the laboratory materials and supplies arrived, delivery was slow. FAO's procurement service in Rome ultimately provided its expertise and support to the country office in concluding this challenging procurement process. By project closure, most equipment and materials had been delivered to NAPHL, but some materials were not delivered due to shipment problems. While delivery of all supplies was delayed, a chemical reagent for food microbiology testing (costing approximately USD 52) arrived in poor condition and was written off.



In addition, reagents worth USD 2 263 were excluded from the purchase order due to challenges with the supplier.

As a result of the delays in the delivery of laboratory equipment, materials and supplies, some capacity-building activities (such as sampling, quality management, instrument troubleshooting and maintenance) were also delayed and some were not concluded by project closure. While some training was carried out for laboratory staff at NAPHL, ESI, the Ministry of Health, Trade and Industry, and the Ministry of Marine Resources, more training on the use of laboratory equipment could have been carried out if the equipment and supplies had been delivered faster, or if the end-user laboratory had not changed from Dekemhare City to NAPHL.

Because of the delays in equipment delivery and change of end-user institution to the NAPHL due to a reorganization within the government, initiation of International Standards Organization (ISO) 17025 laboratory accreditation and related training could not be carried out. With the pending establishment of national food safety laboratory, the Government plans to carry out this activity. In addition, while it was included in the work plan, procurement of ICT hardware was not a major target of implementation. Therefore, the only hardware delivered was a computer to accompany the UHPLC-DAD/FLD laboratory equipment.

Development of the information, education and communication (IEC) package, accompanying training in public awareness raising and sensitization on the importance of quality and nutrition analysis could not be delivered because of the unexpected change in end-user (and therefore implementing institution) from Dekemhare City Laboratory to NAPHL. This affected prompt implementation of laboratory activities, including sampling and testing, which would have generated information to be included in the IEC package. As a result, none of the other activities related to Output 4 on strengthening the capacity of value-chain actors were carried out, including planned workshops and seminars, training of consumers and awareness raising on the importance of food testing and certification.

Following the Government's request to shift the delivery laboratory from Dekemhare City to NAPHL, and in recognition of delays in the procurement process, the project's end date was shifted from 31 August 2019 to 31 December 2019. As a result of late arrival of procured equipment and the delayed project end date, the closing workshop did not take place as planned.

## FOLLOW-UP FOR GOVERNMENT ATTENTION

Regular follow-up is needed to ensure that the equipment provided through the project is put to effective use and furthers the project objective, particularly in light of the shift in end-user institution from the Dekemhare City laboratory to NAPHL. Fortunately, both laboratories are managed by the Ministry of Agriculture: the lead technical officer had previously visited NAPHL and verified its capacity to utilize this equipment. However, since the delivery of equipment was delayed and some capacity-building activities were not carried out, further efforts are needed to ensure that the equipment and materials are utilized sustainably to analyse food in the laboratory.

The national project coordinator and project team were very active and worked closely with the FAO country office. Following project closure, a mechanism should be identified for continued strengthening of coordination among the national project coordinator and team to ensure optimum use of the capacity built and the sustainability of results. In addition, training provided through the project brought together analytical staff from different laboratories and institutions. This network of experts should be sustained beyond the life of the project in order to promote sustainability.

Follow-up may also be needed to ensure that technical and institutional capacity, and knowledge gained through this project are applied broadly within government institutions responsible for food safety and quality, and that the public, the national scientific community and other stakeholders understand the value of country-led quality analysis and assurance processes. In order to promote sustainability, the laboratories involved in these processes can be further strengthened through participation in proficiency testing schemes as they routinely analyse food samples.

The National Food Security and Nutrition Steering Committee plans to establish a national food safety laboratory and attain accreditation. To this end, more capacity building is recommended, especially on sampling, equipment maintenance and the use of ISO standards and laboratory accreditation. While there were some areas in which capacity building was not possible through this project, national laboratory staff gained significant knowledge abroad through study trips. It is recommended that the Government collect more information about this capacity and continuously assess how it is being used.

While the implementation ISO 17025 standards and initiation of lab accreditation could not be carried out as a result of delays in equipment delivery and change of the end-user laboratory, this accreditation and training process is recommended for laboratories such as those in Dekemhare City and at NAPHL. Additional support is recommended to attain accreditation, as well as to maintain it over the long term through proper laboratory management practices. This could include participation in proficiency testing or inter-laboratory testing schemes, as well as additional training on quality management systems and mock laboratory assessment.

Regarding capacity strengthening of value chain actors and increasing demand for high-quality foods, the change in end-user laboratory and placement of the lab equipment at NAPHL precluded all planned activities. The change affected prompt implementation of testing activities, which would have benefitted actors all along the value chain. One lesson learned from the project for the Government was that improved food safety can enhance nutrition and economic development in the country. Given the pending establishment and use of laboratory equipment provided through this project at the future national food safety laboratory, continued liaison with the Government is required to build adequate capacity. This includes increasing public awareness of the importance of food safety and quality through laboratory assessment, the establishment of a national food safety laboratory and a subsequent project with IAEA. Regular follow-up will ensure that these new initiatives sustain the gains made through this project's delivery of equipment, materials and knowledge.

## SUSTAINABILITY

### 1. Capacity development

The establishment of basic operational and quality management systems, including training and capacity building of laboratory staff, was seen as a foundational step in strengthening Eritrea's national food control system. By equipping the laboratory, the project focused on strengthening the technical capacity of stakeholders, enhancing awareness and institutional coordination around food safety and quality assurance, and developing a knowledge base for food-sector stakeholders requiring analytical services. The project's sustainability will be ensured by the Government through the continued provision of appropriate funds for laboratory operation, further capacity building and advisory services.

The project plan included a component on empowering consumers to demand food safety analysis. Such empowerment has been shown to lead consumers to demand quality food that sustains the gains from building the capacity of government and stakeholders. While the empowerment activity was not implemented because of changes in the project timeline, continued partnership with the Government can ensure that consumers' awareness and demand are adequately strengthened.

A number of national institutions, including NAPHL and ESI, have strengthened their coordination as a result of this project. In addition, IAEA is supporting a new food safety project, implemented through ESI, which is expected to build on the achievements of the current project.

### 2. Gender equality

The project aimed to create an enabling environment for food safety and quality assurance through a strategic approach, improving clarity of roles, collaboration and coordination, technical capacities and collaborative efforts in managing food safety and quality. Since both men and women stakeholders are involved in laboratory testing of food in Eritrea, the project's activities included men and women. Women staff were encouraged to participate in the training provided, which ensured that both the needs of both men and women were accommodated. Women also benefited from better-quality food that can enhance the nutrition of their children.

### 3. Environmental sustainability

By ensuring all relevant stakeholders were engaged, the project was able to instil an understanding of the sustainability of value chains for quality foods at the highest levels of decision making. In addition to analysing foods, the equipment provided through this project can be used for environmental testing (such as of pesticides and related persistent organic pollutants). By promoting balanced production systems and improving food safety, the project contributed to increasing trade of agricultural products contributing to sustainable natural resource management.

The project's capacity building component aimed to build the resiliency of Eritrea's food system and contribute to the diversification of agricultural livelihoods, promoting the use of high-nutrition crops. The planned targeted awareness campaigns aimed to raise capacity on the demand side and secure the continued commitment of key stakeholders. While these activities could not be implemented in the project timeline, continued engagement with the lead ministry will ensure that awareness-raising is continually embedded in future activities.

#### 4. Human Rights-based Approach (HRBA) – in particular Right to Food and Decent Work

With the establishment of a national food safety laboratory in the country and strengthening of NAPHL, the project supported sustainable employment creation in the areas of food analysis, food safety and quality assurance. By extending capacity to the private sector, it also aimed to support local food industries and build demand for value-rich, nutritious foods – creating an enabling environment for these enterprises' growth and support to local employment.

#### 5. Technological sustainability

The technology introduced through this project is essential for upgrading national capacity to assess food safety and quality - a government priority and critical for establishing safe and resilient national food value chains. This technology - and the capacity introduced along with it - can also be used by institutions such as ESI and can be shared with a range of public and private-sector actors. These technologies support the testing of a range of hazards (e.g. mycotoxins, drug and pesticide residues, microbial contaminants) as well as proximate analyses of a variety of food products. In addition to food for human consumption, this equipment can also be used to test the quality and safety of water and animal feed. In addition, environmental samples can be analysed with the available tools.

#### 6. Economic sustainability

The capabilities built thus far under the project and follow-up initiatives - if used to promote the growth of value chains for safe and nutritious foods in Eritrea - can contribute to the progressive elimination of tariffs and non-tariff barriers, ultimately enhancing access to regional markets. Increasing public-sector capacity to provide public services related to plants and animal health, food safety and quality, supports market access and sanitary measures for better trade. The Ministry of Agriculture plans to complement these efforts with a follow-up project to operationalize the national safety laboratory, which will ensure the sustainability of these results in strengthening national food value chains through safety and quality analysis.



### DOCUMENTS AND OUTREACH PRODUCTS

#### Equipment training manual (supplier)

- ☐ User manual: Shimadzu Prominence UHPLC-DAD/FLD.
- ☐ User manual: ELISA reader.
- ☐ User manual: Steam evaporator system.
- ☐ User manual: Biosafety cabinet class II.

#### Training manual: Uganda National Bureau of Standards

- ☐ Operating procedures: Operation and care of HPLC, Schmadzi, 12 pp.
- ☐ Test method (Determination of Aflatoxins B1, B2, G1 and G2 by HPLC, 9 pp.

## ACHIEVEMENT OF RESULTS - LOGICAL FRAMEWORK

Expected Impact	Improved quality of the food supply, contributing to improved public health, food security, enhanced nutrition and economic development in Eritrea		
Outcome	An analytical laboratory attached to the production of nutritious food in Dekemhare City established		
	Indicator	Quantity of equipment procured, installed and commissioned.	
	Baseline		
	End Target	100% of ordered equipment procured, installed & commissioned.	
	Comments and follow-up action to be taken	With the exception of 1 consumable (100 ml worth about USD 52) that arrived in poor storage condition and was written off, as well as a couple of reagents (worth USD 2 263.40) that were recommended for removal from the Purchase Order due to supplier/end-user challenges, and thus local procurement recommended, all equipment and related supplies were delivered (the latter albeit delayed). Equipment that required installation were all installed and commissioned with a number of people trained as follows: 1. UHPLC-DAD/FLD concluded February 2020 and seven staff from different institutions trained; 2. Microplate/ELISA reader, installed and six staff trained September 2019; 3. Steam distillation system; completed September 2019 and six staff trained; and 4. Class II Biosafety cabinet installed (plus training) December 2019.	
Output 1	Strengthened coordination mechanisms		
	Indicators	Target	Achieved
	Meeting and workshop; Nomination of the national project coordinator (NPC), establish the Project task force (PTF) and National Project Steering Committee (NPSC).		Yes
Baseline			
Comments	NPC and team were very active and worked closely with the FAO country Office; Mechanism be identified for continued liaison with the NPC and team to ensure optimum use of capacity built and sustainability		
Activity 1.1	Inception meeting		
	Achieved	Yes	
	Comments	A number of institutions participated and expressed willingness to work closely. This has been demonstrated in the trainings where participants from institutions such as NAPHL and ESI benefited.	
Activity 1.2	Nomination of the NPC, establishment of project task force (PTF) and national project steering committee (NPSC)		
	Achieved	Yes	
	Comments		
Activity 1.3	Project closing workshop		
	Achieved	No	
	Comments	The actual closing workshop was not done due late arrival of equipment procured and the NTE date but most of the activities separately like handover, training (on-the-job training) etc. were accomplished on different times basis.	



Output 2	Institutional and technical capacity strengthened		
	Indicators	Target	Achieved
	Training on practical and implementation.		Partially
Baseline	No		
Comments	<p>The following trainings were implemented:</p> <ol style="list-style-type: none"><li>1. Two Dekemhare staff were trained locally at ESI and NAPHL for three weeks to build their capacity in preparation to training abroad (in Uganda);</li><li>2. Two analysts from NAPHL and ESI were trained in analytical chemistry and food microbiology at an accredited laboratory in Uganda for 1 month; and</li><li>3. Five other training sessions associated with instrument installation and use were implemented in-country.</li></ol> <p>More training could have been realized if the delivery of consumables was faster; end-user readiness was not delayed (and required change from Dekemhare to NAPHL).</p> <p>Where possible, a certain level of technical/management follow-up may be considered to ensure that knowledge gained is applied to address the original goals of the project, and passed on to other scientists, and that it is sustainable. Laboratories involved can be challenged through participation in proficiency testing schemes as the routinely analyse food samples.</p>		
Activity 2.1	Training in sampling protocols, method development & validation; Quality Management systems and Laboratory metrology		
	Achieved	Yes	
	Comments	More can be done, especially on sampling. Good knowledge also gained abroad, and it would help to know and continuously assess how it is being used.	
Activity 2.2	Practical training on review and development of methods of analyses in ISO format for tests carried out by laboratory and equipment maintenance		
	Achieved	Yes	
	Comments	There is room to do more, especially on equipment maintenance and use of ISO standards. Good knowledge was also gained abroad, and it would help to know and continuously assess how it is being used.	
Activity 2.3	Install and commission procured equipment		
	Achieved	Yes	
	Comments	Four sets of equipment installed/commissioned	
Activity 2.4	Implement ISO 17025 and initiate lab accreditation		
	Achieved	No	
	Comments	Implementation ISO 17025 and initiate lab accreditation could not be done as there was a delay of equipment delivery and displacement of the equipment to the National Plant and Animal Laboratory due to some organizational changes of the Government. Further/future support recommended to attain and maintain accreditation. This could include participation in proficiency testing or interlaboratory testing schemes, as well as additional training on quality management system, and mock laboratory assessment.	

Output 3	Improved laboratory infrastructure		
	Indicators	Target	Achieved
	Procurement of lab. equipment, materials and ICT hardware.	Analytical instrumentation in place and can be used.	Partially
Baseline	No. There was no instrument that could be used in testing mycotoxins, drug and pesticide residues as well as vitamins		
Comments	Several equipment procured, delivered and installation/commissioning of four sets including a UHPLC-DAD/FLD realized. Many other minor equipment and laboratory consumables were also supplied.		
Activity 3.1	Procure, install and commission laboratory equipment, together with trainings		
	Achieved	Yes	
	Comments	Several equipment procured, delivered and installation/commissioning of four sets including a UHPLC-DAD/FLD realized. Many other minor equipment and laboratory consumables were also supplied.	
Activity 3.2	Procure reagents and materials		
	Achieved	Partially (~98%)	
	Comments	With the exception of a few some reagents that had to excluded from PO (items worth ~USD 2 263.40) as detailed further above, a number of laboratory material were supplied though delivery was slower. Credit goes to the procurement service staff at Headquarters for an excellent job in executing and concluding this procurement.	
Activity 3.3	Procure ICT hardware		
	Achieved	No	
	Comments	ICT was not a major target with the exception of a computer that accompanied the UHPLC-DAD/FLD	
Output 4	Capacity of value chain operators strengthened		
	Indicators	Target	Achieved
	Development IEC package, training, sensitization and awareness creation.		No
Baseline	No		
Comments	There was a change of end-user (and therefore implementing organization/institution) as well as placement of the lab. Equipment, by Government. Continued liaison to ensure capabilities built can address the original target of the project.		
Activity 4.1	Develop IEC package for consumers and the general public		
	Achieved	No	
	Comments	The same reason as the output.	
Activity 4.2	Prepare workshops and awareness seminars, and conduct training of consumers		
	Achieved	No	
	Comments	The same reason as the output.	
Activity 4.3	Sensitize and create awareness on the importance of food testing and certification.		
	Achieved	No	
	Comments	The same reason as the output.	

**Partnerships and Outreach**

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