

Annex 5

WORKING PAPER
on

Review of Laboratory Capacity in Zambia to Meet SPS Requirements

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INRODUCTION AND METHODOLOGY

Over the last 30 years agribusiness has evolved into a global business. Consumers are demanding fresh fruit and vegetables year around; they want fewer processed foods. In order to meet these demands, food companies are purchasing materials from around the world creating a demand for products from Africa, Asia and Latin America. With this demand also comes an increased requirement for compliance.

In order to assure the buyers and importing nations that the materials are safe, companies and governments are having to meet an ever-increasing array of international (SPS) and private (EurepGAP and BRC) standards. A key component of all of these systems is testing. As Zambia aims to increase its share of world trade and improve public heath and safety, a critical component will be the country's diagnostic system. Therefore, the World Bank and USAID created a joint team to evaluate Zambia's diagnostic capability as it relates to SPS.

In order to understand the current state of Zambia's system of testing, the team visited the main laboratories and interviewed current stakeholders. These included the government and university laboratories, and a cross section of companies, trade associations, donors, and ministry officials. The production and manufacturing companies represented current exporters, fresh vegetables, high-risk products such as meat, poultry, dairy, eggs and baby food, as well as high volume producers of beverages and bottled water. In addition, the team interviewed buyers such as retailers, hotels, and fast food chains, which in many countries set the standard of performance in the area of food safety and quality.

This report contains a summary of the findings, a set of options for improving diagnostic capacity and several specific actions for government and donors to strengthen the overall diagnostic system.

SUMMARY

The ability to test food, animal feed, and water for safety and compliance to standards is a fundamental requirement for the protection of human and animal health and is a key component of manufacturing and trade. Farmers, growers, processors, traders, importers, exporters, and consumers need to have an understanding of the quality and safety of the products they are buying and selling. Testing provides each of these with the confidence that the product they produce or sell meets the specifications as defined by the customer, Zambian regulations, or by the regulations of Zambia's trading partners.

In general, testing services are expensive to develop and support. Laboratories require highly skilled and trained technical staff, proper facilities, specialized equipment, ongoing equipment and facility maintenance, reagents, standards, chemicals, and staff training. Because of the high initial investment and ongoing costs it was important to evaluate Zambia's diagnostic system relative to four key areas:

- testing capacity,
- laboratory capabilities,
- quality awareness, and
- domestic demand for services.

Testing capacity and laboratory capability combine to create the foundation for any diagnostic system. They deal with the operational issues, such as can the correct tests be performed, are the laboratories operating to a known standard, what tests are they capable of running and are the samples processed in a timely manner.

Quality awareness and domestic demand address the sustainability of a system. There must be sufficient demand for a laboratory testing system to be sustainable. Currently, the volume of exports in Zambia is too small to support a diagnostic system. Therefore, industries serving the local market should be targeted to use laboratory services, which could allow for cost recovery and re-investment. It is therefore important to create increased demand for laboratory services; this could be achieved by good promotion to create awareness, a positive image and brand for these services.

TESTING CAPACITY

The laboratory services in Zambia are fragmented between public, university and company laboratories. Public and university laboratories provide similar tests and services. These include: physical properties (pH, weight, moisture, ash, protein ...), chemical residues, heavy metals, mycotoxins, yeast and molds, GMO, and microbial analysis. There are five primary laboratories that provide testing of agricultural products, animal feed and processed food:

- Zambian Food and Drug Control Laboratory,
- University of Zambia, Food Science and Technology Laboratory,
- National Institute for Science and Industrial Research,
- Central Veterinary Research Institute, and
- Crop Protection Laboratory.

The Zambia Bureau of Standards (ZBS) was not included because, as of May 2006, it did not have the equipment or trained staff to test agricultural products or water. Instead, any tests that are “performed” by ZBS are on a contract basis for food, beverages, and agricultural products.

These five primary laboratories perform a wide variety of tests, on a broad range of products, for a variety of markets. The range of products tested includes:

- Poultry – mainly testing for Salmonella
- soy meal
- soy beans
- fortified maize meal
- maize
- fortified sugar
- animal feeds
- peanuts

- chili peppers
- vegetables
- water
- juice, and
- dairy products.

None of the laboratories were working at full capacity – in fact most were working at way below their potential capacity. Despite this, the turn-around time for samples was excessively long, especially for chemical and microbial analysis. This was due to a lack of on-hand reagents and the time to procure them. The ordering system within the ministries is long and complex. Following a request for reagents, it takes 6 to 8 weeks before a purchase order can be cut and another 2-3 weeks before the supplies are delivered. The consequence is that while the laboratory may have the capability to perform the test, the length of time to obtain results drives many industries and companies to seek alternatives.

PUBLIC AND UNIVERISTY LABORATORY HIGHLIGHTS

NATIONAL INSTITUTE FOR SCIENTIFIC AND INDUSTRIAL RESEARCH

National Institute for Scientific and Industrial Research (NISIR) was established in 1997 through an act of parliament and is a part of the Ministry of Science, Technology and Vocational Training. NISIR is responsible for basic research and development in six major areas: tree improvement, livestock and pests, water resources, radioisotopes, building material and minerals, and food technology. The Food Technology Research Unit (FTRU) conducts research in the areas of fruits and vegetables, cereals, tubers and legumes, biotechnology, and food chemistry and engineering. This organization plays an advisory role as it relates to policy in the area of biotechnology and food safety. NISIR participates on key committees as needed. It is an active collaborator with donors in the area of food safety. For example, NISIR was a part of the street vendors program sponsored by DFID and a part of the World Food Program’s fortified maize meal development. In addition, NISIR provides contract microbial, physical property, and pesticide testing to the food industry for water, juice, maize meals, and animal feed. Within the FTRU there are about 12 people.

ZAMBIA FOOD AND DRUG CONTROL LABORATORY

The Zambia Food and Drug Control Laboratory (ZFDCL) was established as a part of the Food and Drugs Act and is a part of the Ministry of Health. It is through the authority of the Ministry of Health that ZFDCL has the authority to test food products for compliance with the regulations and standards as defined by the Act. Testing of food products is voluntary and not required for sale; therefore the number of food samples tested is limited. ZFDCL has received support from UNICEF, USAID, Centers for Disease Control, FAO, International Atomic Energy Commission and others. This support has been for equipment as well as training. ZFDCL responsibilities include analysis on narcotics, human-poisoning, and water quality. These non-foods related tests are the largest component of the work. ZFDCL provides contract-testing services to food and beverage industry. These tests include: product quality, composition, microbial analysis, physical properties, and

chemical analysis. The organization employs about 25 people.

UNIVERSITY OF ZAMBIA, DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY

The Department of Food Science and Technology (DFS&T) has only recently been established in the Faculty of Agriculture of the University of Zambia. In 1997, the University of Zambia implemented the Institutional University Co-operation (IUC) Program referred to as the VLIR-UNZA IUC Program. IUC is an Inter-University co-operation Program of the Flemish Inter-University Council (VLIR). The Ghent University coordinates the VLIR-UNZA IUC Program. The Program is based on funding provided by the Belgian Government through the Directorate General for Development Co-operation (DGDC). The DFS&T has three core activities: training (teaching), research, and public service. In the area of public service, it provides training and consulting in food safety, food chemistry, nutrition and testing services to the food industry. DFS&T provides microbial analysis, chemical analysis, physical property testing, and water analysis. About 10 people work in the DFS&T.

CENTRAL VETERINARY RESEARCH INSTITUTE

The Central Veterinary Research Institute (CVRI) was founded in 1979 and is a part of Ministry of Agriculture. The main laboratory is located outside of Lusaka with five satellite “laboratories” located in the regions. CVRI has five main objectives or activities:

- to provide laboratory diagnosis of livestock disease and advise farmers and field services on the control of animal diseases,
- to produce animal vaccines and other biologicals,
- to provide epidemiological surveillance and disease investigations,
- to conduct research in the area of animal diseases, and
- to provide training to students.

Within the organization there are nine sections:

- acaricides (medicinal soaps and cleaning solutions for animals),
- bacteriology,
- biochemistry and toxicology,
- parasitology,
- pathology,
- quality control and assurance,
- vaccine production unit,
- virology, and
- epidemiology.

About 65 people work in the CVRI and its satellites. The laboratory receives some support from donors (FAO, International Atomic Energy Commission and the EU). This support is for specific programs such as FMD and Swine Fever. CVRI tests for scheduled and non-scheduled diseases.

Scheduled diseases include: East Coast Fever, Contagious Bovine Pluero Pneumonia, Tuberculosis, Anthrax, Foot and Mouth Disease, and African Swine Fever. In addition, the laboratory provides microbiological testing for E. coli and Salmonella.

ZAMBIA BUREAU OF STANDARDS

The Zambia Bureau of Standards (ZABS) was established in 1982 by Act No 22, which was later repealed and replaced in 1994 by the Standards Act 416. The Act 416 redefined the functions, responsibilities and powers of the Bureau and established broad stakeholder participation, with delegates from government, research centers, universities, industry, professional associations and consumers. The Standards Council of Zambia was also created to oversee the operations of the organization. ZABS five key activities include to:

- develop, promote, and establish standards (its primary activity)
- develop testing protocols for products
- provide for pre-export inspection of export commodities
- provide training in the area of quality systems, management, and assurance, and
- establish metrology and other testing laboratories.

Today ZABS has about eleven standards that are related to the food and beverage industry. These standards cover a wide range of products including animal feeds, bottled water, canned pineapples, jams and jellies, margarine, and wheat flour. ZABS is the selling agent in Zambia for foreign and international standards, such as the International Organization for Standardization (ISO), the African Regional Organization for Standardization (ARSO), and national standards of many countries in the world. ZABS is not a full member but observer member of ISO, ARSO and IEC.

The Zambia Bureau of Standards Metrology Laboratory (ZABSML) was created about ten years ago with donor funding and has established a good reputation for service and performance. The laboratory provides calibration in the areas of weights, length, and pressure. The range of tests is limited by availability of standards and testing equipment.

ZABS implements standards through a certification mark scheme where products conforming to Zambian Standards are given a mark. It operates a voluntary product certification scheme, in which some local companies, mostly producers of processed food and bottled water, participate. While this mark does exist there were few companies that either advertised certification or used the mark on products thus limiting the value and consumer recognition of the mark. The Bureau has 55 employees, 35 of whom are technical staff.

LABORATORY CAPABILITIES

Because of the breadth of the markets and products covered in this study the Team used a broad assessment based on ISO 17,025 and Good Laboratory Practices (GLP) to evaluate capabilities. These standards are used for evaluation of the systems and processes internationally and cover areas required to have a well-operated diagnostic system.

This evaluation covered the following areas:

- management procedures and systems,
- quality systems,
- human resources,
- documentation and control,
- inspection and calibration of equipment,
- facilities,
- equipment,
- corrective actions,
- training,
- standards, and
- access to reference materials.

In addition to determining overall general capabilities this assessment also evaluated the laboratories' ability to conduct a broad range of tests. These tests included:

- General product specifications, e.g.
 - weight
 - water content
 - color
 - conformance to quality specifications
- Pesticide residues
- Microbial testing
- Mycotoxin testing
- Animal diseases
- Plant diseases
- Standard analytical techniques (IR, GC, GC-MS, LC, AA, pH)

Laboratory capabilities ranged from poor to approaching the standard that could achieve internationally recognized certification. For the purposes of this study we evaluated public, university, and internal company laboratories.

GENERAL COMMENTS

PUBLIC AND UNIVERSITY LABORATORIES

In general, the public sector laboratories have been neglected and under-funded for the last 20 years and are therefore not in a position to offer quick and reliable services. As a result of the under-funding, some buildings are in need of renovation and, in many cases; although the equipment is operational it needs repair and calibration. In addition, there is a lack of computer access, journals and reference texts. None of the laboratories has an operational quality assurance program, there is a need for standardized methods, processes, and systems and there is a shortage of reagents, consumables, and standards. Staff and management need training in several technical areas and overall laboratory management. Finally, the pricing structure needs to be evaluated and in most cases increased – it should be based on a cost recovery model including investment.

COMPANY LABORATORIES

The contrast between the company laboratories and the public/university laboratories is stark. Because of the need for timely and accurate results to manage their business, some companies have built their own laboratories. These are designed to meet the needs of the company but they could also operate as a commercial entity. In general, the private sector laboratories are well-equipped with materials, consumables and adequate equipment. They have proper management systems, processes, standard operating procedures, methods, and quality assurance. They have the capability to standardize and calibrate equipment. The staff is well-trained and all of the laboratories have a maintenance program for the equipment. In several cases the companies participate in inter-laboratory studies that measure their performance relative to others. The facilities are clean, neat, orderly and in good shape. The companies provide for ongoing training of employees. For the tests that are either very complex or where only a limited number are performed each year, such as pesticide residue, companies arrange for the analysis to be performed by external laboratories mainly in Europe. These companies have found that the investment in the test equipment, training of staff, and ongoing support are just too high for the limited number of samples that are tested each year.

Table 1 summarizes the performance of the laboratories in Zambia. For the purposes of this study the team created a composite score for the company laboratories.

TABLE 1: SUMMARY OF LABORATORY CAPABILITIES

Area	Border Post	Plant Protection	UNZA, Food Science	Food & Drug	Central Vet.	NISIR	Private labs	Key NA = Not applicable UNK = Unknown 0 = Total absence of system or capacity 1 = Minimal system/capacity/process in place, yet clearly inadequate or dysfunctional 2 = System/capacity/process has some functionality and demonstrate competence 3 = System/capacity/process has good functionality, although is not validated through audits or recognized internationally 4 = Systems/capacity/process functions well and meets international standards 5 = Approaches international better/best practice and is audited
Quality systems and process	0	1	2	2	2	2	4	
Personnel (staff qualifications)	2	3	3	3	3	3	4	
Personnel (training)	0	0	3	3	3	3	4	
Management systems	0	1	2	2	2	2	4	
Written procedures, checklists, defined tasks	0	1	1	1	1	1	4	
Microbial testing	0	2	2.5	2.5	2	3	3	
Analytical testing (includes chemical and measurements)	0	0	2	2	0	3	4	
Entomology diagnostics	0	3	NA	NA	NA	NA	NA	
Animal zoonotic disease tests	0	NA	NA	NA	3	NA	UNK	
Plant pathology	0	3	NA	NA	NA	NA	NA	
Access to internet	0	2	2	2	2	3	4	
Equipment	0	2.5	2.5	2.5	2	2.5	3.5	
Method development	0	0	1.5	1.5	2	1.5	3	
Testing methodology	0	UNK	2	2	2	3	4	
Internal audits	0	0	0	0	0	0	3	
Records/reports	1	2	UNK	2	2	2.5	3-4	
Facilities	0-1	2	2.5	2.5	1	4	3-4	
Access to reagents/spares	0	1	1	1	1	1	4	
Repair services	0	1	1	1	1	1	4	
Test standards	0	2	1	1.5	2	2	4	

competence

3 = System/capacity/process has good functionality, although is not validated through audits or recognized internationally

4 = Systems/capacity/process functions well and meets international standards

5 = Approaches international better/best practice and is audited

As can be seen from the analysis presented in Table 1, the public sector laboratories need improvement or need to develop key capabilities in order to provide the testing and services required. These deficiencies impact exports and more importantly impact the ability of the country to protect its citizens from food and water-borne diseases.

This lack of capability in the government is not due to a lack of desire by the staff. Instead the laboratory system creates several barriers to success. These barriers can be combined into three areas: structural and procedural, infrastructure, and knowledge.

BARRIERS TO SUCCESS FOR GOVERNMENT AND UNIVERISTY LABORATORIES

STRUCTURAL AND PROCEDURAL BARRIERS

1. **Lack of Clarity of Roles and Responsibilities:** In Zambia, the government laboratories fall under four separate ministries (Health, Ag, Trade and Research, & Votec). This situation leads to a lack of clarity as to the roles and responsibilities of the laboratories. It also creates redundancy and a competition for scarce human and financial resources. For example, the Zambia Bureau of Standards and the Food and Drug Laboratory both believe they have regulatory authority and responsibility for testing processed foods (imports and exports) for compliance with standards. Thus both laboratories are proposing to begin testing imports and exports. Also, the Central Veterinary Research Institute is requesting funding to study meat butcheries and supermarkets for pathogens and bacteria. While this testing would be of great value to consumers and buyers, it falls under the domain of the Environmental Health Department and Food and Drug Laboratory.
2. **Purchasing of Materials and Services:** All of the government laboratories must use the government requisition process. This process takes 8-12 weeks for a simple request to be processed and a purchase order cut. Then it takes another 2-4 weeks for the material to be delivered, as many of the reagents and consumables are ordered through Zambian agents who purchase in South Africa, Europe or the United States.
3. **Equipment Maintenance:** All of the laboratories reported difficulty in getting parts and service for their equipment. Much of this equipment is old and many of the suppliers either no longer manufacture parts or they are no longer available. In addition, service agreements for new equipment are not in place to allow for the repair of the equipment. Instead, these services are provided on an “as needed” basis, which over time reduces the performance of the equipment, eventually rendering it useless.
4. **Calibration:** Today only laboratory scales can be calibrated and traced back to international standards. This service is provided by ZBSML. All other equipment such as volumetric flasks, temperature gauges, and thermometers are either not calibrated or are self-calibrated. As temperature and volume are critical measurements to any laboratory, it calls into question the accuracy and reliability of results.
5. **Standards and Methods:** None of the laboratories in Zambia has a process or system to develop, test and validated methods or standards. In many cases, they use international methods (AOAC, Codex, ISO, ISP) but because of the non-availability of reagents and consumables, many of these tests are modified and adapted. These adaptations are not standardized or validated, calling into question the validity of the data.
6. **Inter-Laboratory Testing:** There is not an organized system to conduct inter-laboratory testing. Inter-laboratory testing is where laboratories test a common sample using the same test method and then they are able to see how they are performing relative to peers and an absolute standard. This system helps laboratories identify problems, improve capabilities and

strengthens the overall procedures. It also allows results from one laboratory to be compared with another with confidence.

INFRASTRUCTURE

1. **Facilities:** In the cases of the Food and Drug Laboratory as well as the Central Veterinary Research Institute, the buildings are in need of significant repair. In both cases, the roofs leak, which means during the rainy season the equipment, is at risk and inhibits proper testing and analysis.
2. **Protective Equipment:** All of the laboratories work with hazardous materials, chemicals, and biological agents. However, due to a lack of funding they all have poor ventilation systems exposing the staff to toxic substances, which can impact their health and safety. Most of the laboratories have some hooded or controlled ventilation but it was inadequate or not operational for the tasks. For example, while the Central Veterinary Research Institute has a Bio Safety Level 3 hood which is required for virus isolation to protect the staff, it is not fully operational, placing the staff at significant risk if they have to isolate a virus such as the highly pathogenic Avian Flu. In addition, employees need personal protective equipment including gloves, eye protection and thermal clothes. Fire suppression devices, such as extinguishers, were limited creating the potential for serious damage to people and property.
3. **Water, Electricity, and Temperature:** All laboratories require a source of clean and de-ionized water to conduct their work. However, all the laboratories visited had some water sources but the availability of de-ionized water was limited or not available. Because of the lack of de-ionized water, specific water tests cannot be performed and critical reagents cannot be prepared reducing the laboratories' overall performance. Further specific tests and equipment (aflatoxins by HPLC) require highly purified water that must be purchased for this specific purpose, which is not possible under the current funding. Without electricity much of the equipment in a laboratory is rendered inoperable. In addition electrical spikes can destroy most laboratory equipment. For example, the Crop Protection Laboratory had a -80°C freezer that is critical to the storage of virus and pathogen samples. This freezer was broken and cannot be repaired as the electronic controller system was damaged during a power spike. Further key reagents, supplies, viruses, bacterial and pathogenic samples that must be stored in a cold environment are destroyed when warmed above critical temperatures. The Central Veterinary Research Institute has lost months of vaccine products when the power was disrupted and the refrigeration unit warmed to room temperature.
4. **Computers and Internet Access:** Each laboratory had one computer and some limited access to the Internet. Where they have access to the Internet, the costs were high as they are charged by the minute over very slow dial-up lines. This inhibits laboratories from undertaking research or keeping up to date with the latest diseases, communicating with colleagues and participating in formation networks or on-line training. The low level of computerization means that simple things such as tracking disease by region, geography and correlating with human, animal, or plant populations are not possible – which limits the effectiveness of the overall data. Further, the lack of training on computers and

systems means that validation of data using statistical tools was not available, creating uncertainty in results.

KNOWLEDGE

- 1. Training:** All of the laboratories participate in a variety of local, regional and international training. There is the need for specialized and updated training in many areas but this must be tailored to the capabilities of the laboratory. For example, a scientist recently attended a course on the use of PCR for the rapid pathogen testing of food samples - the technique is well proven and would be of value to Zambia, except that no laboratory has either the PCR equipment or a budget to purchase it.
- 2. Laboratory Management:** The management of a laboratory is complex task. The managers must not only be technically competent, but must also have management and human resource skills. The team noted that there had been limited training on ISO 17,025, but there was a need for laboratory management training as well. Each laboratory should maintain key metrics, operating procedures, have a mission and vision as a way to understand their overall performance and ability to meet the needs of their clients.
- 3. Information Sharing:** Because of the diverse locations of the laboratories there is not a forum to share information, techniques, or new technologies.
- 4. Quality Assurance:** All of the laboratories want to be accredited or certified to ISO-17,025. In order to achieve this, the management and the staff need to be trained on ISO, quality management, and quality assurance techniques. Then each of the laboratories must develop and institute systems, processes and standard operating procedures. Through standardization, each of the laboratories will improve their overall performance, capabilities, and reliability of their testing.

QUALITY AWARENESS

There appears to be little consumer awareness or demand for safe food and water in Zambia. It is unclear if this is due to a lack of a perceived need, a belief that branded products are safe, or if products purchased at certain locations are by definition safe, again relying on the power of the company brand. While Zambia Bureau of Standards does have a quality mark, it has received little use or acceptance. In addition, companies that manufacture bottled water are using the name of specific testing laboratory such as NISIR as *de facto* marks or seals of quality. Product labels state that the product has been tested by NISIR or another organization, implying that the water is safe. In this case, while the label carries a statement of testing, none of the public testing organizations we visited had the sampling protocols, systems, processes, or sample chain of custody to insure that the water samples tested were representative of what was being sold.

One exception to this lack of domestic quality awareness was in the area of animal feed. Buyers are keenly aware that if the feed is of lower quality or does not have the right ingredients, then the growth and productivity of the animals will suffer. Therefore, the feed mills are testing their products to insure they conform to what is advertised as well as checking the quality of incoming

raw materials. This testing is being done at company laboratories and public laboratories. There is a project proposal to create a feed-testing laboratory and quality seal program that is being put forward by the poultry association specifically to support the feed mills.

Finally, of course, there is the formal export market. In this case the testing is generally done in the receiving country. In this way the importer can be assured that the results are accurate and that the products meet specifications.

DOMESTIC DEMAND

The demand for testing services within Zambia is low. It is estimated that the total cost of the testing being done for the private sector is about USD130,000. This does not include the cost of “in-house” testing, which many companies have established because of the poor service being offered by the public sector. Some of these private laboratories were visited and their capabilities assessed (Table 2). While this is not a complete list it does represent some of the larger opportunities for testing services that would help support a diagnostic system.

TABLE 2: COMPANY LABORATORY CAPABILITY

Company	Microbial	Chemical	Physical properties	Mycotoxins	Water	Outside Test Services
Parmalat	No	Yes	Yes	No	Yes	No
Eureka Chickens	Yes	Yes	Yes	No	No	No
Tiger Feeds		Yes	Yes	No	No	Yes
Cheetah	Yes	Yes	Yes	Yes	No	Yes
Zambian Breweries (Coke)	Yes	Yes	Yes	No	Yes	No
Specialty Foods	No	Yes	Yes	No	No	No

The responsibility for safe and quality foods is shared

by all participants in the food chain. Unfortunately in Zambia there is a lack of demand by major retailers, hotels and fast-food chains for a testing of food products. Therefore, the amount of testing performed for products sold into these markets is minimal to non-existent. Table 3 is a summary of key product groups that typically require testing based on what is required in other countries. It is interesting to note that several of the key product types such as meat, processed meats and even baby formula are not tested in Zambia yet these can pose a significant risk to human health. It is unclear what impact, if any, a large outbreak would have on the reputation of the manufacturer, the seller, or on the long-term revenues generated by the products.

TABLE 3: PRODUCTS THAT TYPICALLY REQUIRE TESTING FOR FOOD SAFETY

Industry	Tested in more developed countries	Tested in Zambia by non-company labs	Required testing by Clients in Zambia	Required to export
Dairy, cheese, butter, yogurt	Yes	No	No	Yes
Fluid milk	Yes	No	No	Yes
Processed meats	Yes	No	No	Yes
Bottled water	Yes	Yes	Yes	Yes
Juices	Yes	Some	No	Yes
Seafood	Yes	No	No	Yes
Poultry	Yes	Yes	Yes	Yes
Infant feed or formula	Yes	No	No	Yes
Raw meat	Yes	No	No	Yes
Spices	Yes	No	No	Yes
Grains	Yes	Unk	No	Yes
Animal feed	Yes	No	Yes	Yes
Fresh Fruit & Veg	Yes	No	No	Yes

OPTIONS AND RECOMMENDATIONS

The team identified four options that are available for improving the testing and analysis performed by the laboratories serving the food and agricultural sectors. Each of these options has pros and cons but all are realistic and need to be evaluated as a part of a strategic process.

OPTION 1: MAINTAIN THE STATUS QUO

In this option the current state is basically maintained and investment by the government, industry, and donors will continue on as is.

Strengths

1. This option requires little to no additional investment over current funding levels by the government.
2. Training will continue on an “as needed” basis, with support from donors.
3. The private sector will continue to invest in internal laboratory capacity to meet their business needs.

Weaknesses

1. The overall capacity in the public sector (people, facilities, and equipment) will continue to degrade.

2. Capability that is required for export or domestic food safety will be built by industry or more likely the funds will be spent in other countries. For example, PCR-based testing required for honey to be exported to South Africa will be conducted in another country such as Uganda.
3. Industry will continue to absorb the costs making it even less competitive.

OPTION 2: TARGETED INVESTMENT

This option focuses on targeted investment by donors in laboratory capacity building. It is a system where there is *ad hoc* investment to meet the needs of specific projects or exports versus strategic investment that focuses on the broader needs of the government related to public safety. An example of this would include investment by the EU to add capacity at ZBS for metrology and food safety testing. Additional metrology capacity is needed and would be of great value to Zambia; however, the need for additional food safety testing is very limited.

Strengths

1. Build capacity as need to support key programs or projects.
2. It can help to retain key staff at least for a period of time.
3. It can create mini-centers of excellence in specific tests or capabilities.

Weaknesses

1. It will build redundant capacity as donors invest in additional equipment or capabilities that already exist in other laboratories.
2. Creates a competition for key resources as donors tend to draw on the same highly qualified staff.
3. Adding redundant capacity limits the system's ability to be self-sustaining.

OPTION 3: CONSOLIDATION OF GOVERNMENT TESTING

In this option the government combines the facilities, manpower, budget and revenues of the key food-testing laboratories and creates a Diagnostic Center of Excellence that is designed to support government, university, and industries needs. The concept is consistent with what Zambia has done in other areas such as the University Teaching Hospital in Lusaka.

Strengths

1. It eliminates the redundancies between laboratories.
2. Creates the critical mass of people, equipment and facility utilization required to support a laboratory system.
3. Eliminates fragmentation of investment and donor dollars.

4. Helps retain critical staff.
5. May lead to offering additional services, such as consulting and training.
6. May lead to quick accreditation of at least one food-based laboratory in Zambia.

Weaknesses

1. Requires four Ministries to agree.
2. Conflicting goals and objectives for each Ministry.
3. May require changes in the laws and legal framework.
4. Requires coordinated investment by the donor community.
5. May not replace private sector investment.
6. May not meet the requirements of an accredited private sector laboratory.

OPTION 4: PRIVATE LABORATORY

This option does not appear to be viable until the demand for testing services increases. If salmonella testing of poultry is excluded, the total testing that is being done on food for a fee by the government laboratories is about USD65,000. Even if the charges were brought more in line with a cost recovery and re-investment model, the current expenditures would double to about USD130,000, which is not enough to interest a private organization to invest in a new laboratory.

It may be possible to encourage companies such as Tiger Feeds and Cheetah to expand their services but this will only occur if there is a demand. For example, Cheetah is well qualified to conduct Mycotoxin testing on grains, coffee, nuts etc. But, in order to conduct a broad range of testing, they will need to purchase a modest amount of equipment (specialty columns and reference samples). As they are a private company, they will need some guarantee as to the number of tests that will be performed because they would not incur additional expense if there were no real market. In contrast, if similar testing was to be performed by the government laboratories or the university laboratory they would need to invest in new equipment, detectors, as well as the consumables (columns and standards), and would need to train staff on the testing. So while the capacity could be added within the government it would be significantly more expensive and time consuming than working with a private laboratory such as Cheetah.

ALTERNATIVE: MINI-CENTERS OF EXCELLENCE

All of these options could be implemented, but some have more advantages than others. However, during discussions with donors, it was suggested that a modification of Options 2 and 3 might be practical. This variation would create mini-Centers of Excellence for key capacity. It would allow for continued targeted investment but would strengthen key areas as opposed to simply adding a piece of equipment. Donors could help create these Centers of Excellence by allowing all of the public laboratories to bid for the donor monies for specific diagnostic areas and then, based on certain criteria, one would be selected.

One methodology that can be used is to have each of the bidding laboratories create a mini-business plan to justify why they should receive the funding. This business plan would include:

- a market assessment,
- current capabilities review,
- review of how and by when the laboratory is going to institute quality assurance practices and achieve ISO-17,025 accreditation /certification,
- a review of the personnel who will be involved in the testing,
- a detailed budget including cost estimates, expenditures, and revenue.
- a marketing plan that describes how the entity will market and sell the services such that they can create a sustainable business.

Using a business plan process may not be applicable to all donor interventions, but it could be a way to establish concrete goals; objectives and key performance indicators for laboratories.

Two key areas of investment are in microbial and chemical analysis. These require specialized equipment and facilities, a high level of staff training and a significant throughput of samples to maintain operator skills. Both are crosscutting services that support a variety of government agencies and food sectors and currently neither are being effectively serviced. Finally, these two areas are important for exports and ensuring public health and safety.

Ultimately, the option that is chosen must support the government's overall strategy as it relates to trade, investment and public health and safety. Safe food, animal feed, and water are key elements of any government strategy but how they are achieved, to what level, and by when is the domain of the government.

FUTURE ACTIVITIES

As with all projects there are things that can and should be done in the near term that will support and enhance any and all of the options. Each of the activities will impact each of the groups differently and some will take longer than others. Table 4 outlines a series of activities and provides some guidance as to level of importance and timing. The reader will note there is a mixture of strategic and tactical elements. We have not, as others in the past, provided a list of specific equipment for each of the laboratories. Instead if donors or readers are interested in very specific needs they can contact any of the laboratory directors and they will provide an updated list of needs.

If an inter-ministry management team or forum is created, it should evaluate the priorities and

programs briefly described above and determine an action plan for Zambia's laboratory systems.

TABLE 4: FUTURE ACTIVITIES

Activity	Improves capacity	Improves capabilities	Improves quality awareness	Improves demand	Relative priority	Time frame
Create a Laboratory Management team (including Government, University, and Industry laboratories, and Trade Associations)	X	X	X	X	H	M
Agreement on the roles of the laboratories to reduce possible duplication of effort	X	X	X	X	H	M
Conduct a survey of current and potential buyers of laboratory services to determine what services are needed, what volume they commit to, and approximate price/value they are willing to pay	X	X	X	X	H	S
Organize/combine/coordinate purchasing mechanism for all government laboratories to maximize buying power for consumables		X			M	S
Create a consolidated maintenance agreement and coordinated maintenance plan to optimize service and equipment uptime		X			M	S
Work with the EU to expand the metrology services to include temperature and volume and expand current weights, length and pressure	X	X		X	H	S

Begin a laboratory training program for management and staff on quality systems, processes, and management, open to public and private sector	X	X	X	H	M
Provide support to the laboratories to create and implement an operations and quality manual that conforms to ISO	X	X			
Under the direction of ZBS begin inter-laboratory testing in critical areas such as water quality, chemical analysis, and microbial analysis. This will include public, university and private laboratories	X	X	X	M	M
Improve infrastructure at key laboratories including back-up power and surge protectors and water stills	X	X		H	S
Facility improvements including roofs, hoods, ventilation	X	X		H	L

Key
S = Short-term [6 – 12 months]
M = Medium [12 – 18 months]
L = Long [18 – 24

months]
H = High priority
M = Medium priority
L = Low priority