Sustainable Labs

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Project Objective:

Broader Goal:

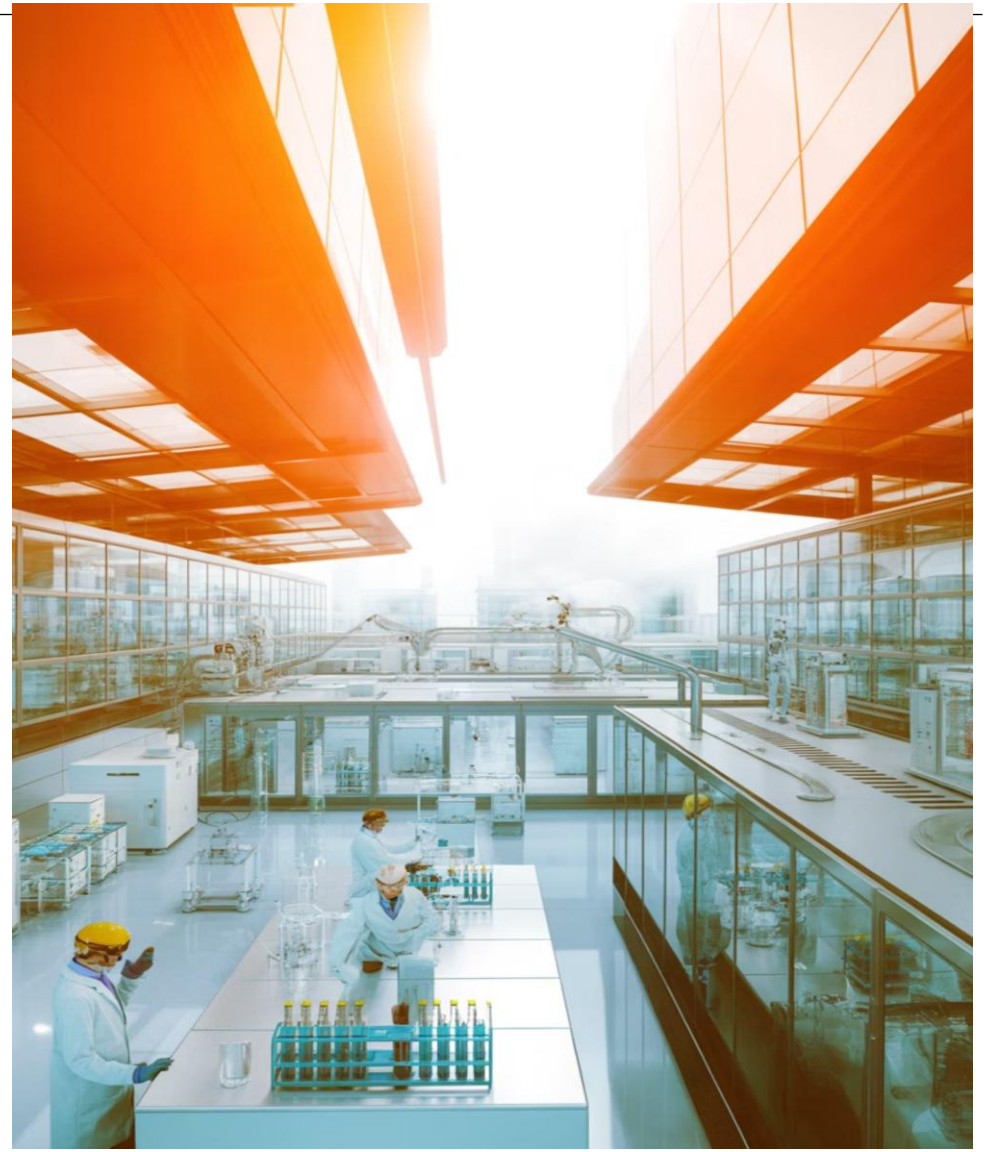
Support Global Affairs Canada in mitigating threats from inadequately secured high-consequence pathogens, strengthening global health security infrastructure.

Global Initiative

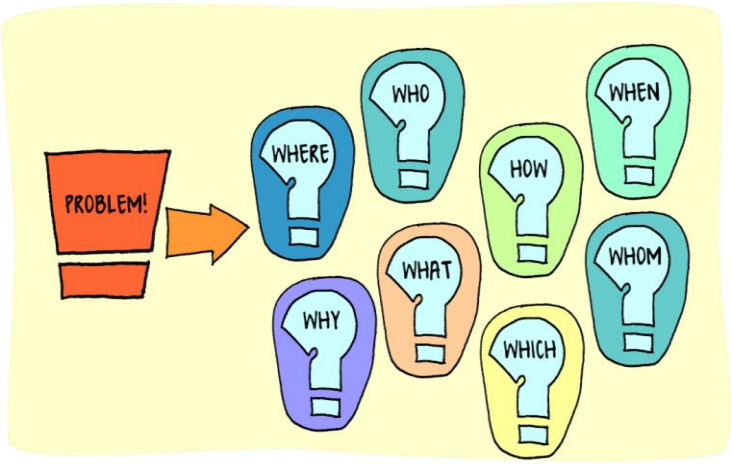
Deliver a global innovation campaign to pioneer a new type of diagnostic biological containment laboratory for resource-challenged environments.

Program Affiliation

This project is a component of Biological Preparedness and Resilience through Evolution and Innovation of Laboratories (BioPREVAIL).



Expected Outcomes



01 Problem Identification

Assess labs and identify key challenges at each facility to address longstanding laboratory issues.

02 Threat Reduction

Reduce biological proliferation threats through innovation and improved biosafety and biocontainment

03 Enhanced Sustainability

Enhance sustainability and maintainability of laboratories in low- and middle-income countries (LMICs).

04 Community Expansion

Strengthen national and regional capacities to prevent, detect, and respond to infectious disease outbreaks

05 Capacity Strengthening

Expand the global health security community dedicated to advancing innovative lab capacity-building solutions.

Background: Project Genesis

1 **December 2024**

Pond and AFMS presented a Sustainability Concept Project to Global Affairs Canada. This comprehensive 8-Task proposal started with 3 initial Tasks associated with Problem Identification, laying the foundation for systematic laboratory assessment.

2 **March 2025**

As recognized leaders in the programming, design, construction, and maintenance of containment laboratories, Pond & Company and AFMS were contracted by Global Affairs Canada (GAC) to perform the first 3 Tasks associated with Problem Identification.

3 **Current Phase**

This stage of the project evaluates current diagnostic laboratories, preferably BSL3, to understand operational and maintenance challenges. Essentially, this stage focuses on *Problem Identification*. The forthcoming stages will take the information gathered to develop *Solutions*.

Background

- **Task 1** is Problem Identification and will be a collective and comprehensive list of issues that include Organisational/ Operational, Technological, and Environmental topics, but with a primary focus on issues of engineering and maintenance concern.

- **Task 2** is to develop a quantification of the items and issues identified in Task 1. We will create a measuring stick through identification and quantification of what is a successful and/or failed facility. Eg. Ops Budget, energy consumption, number of tests and/or TAT, safety record, training records, certification records, sample shipping time, etc.

Background

- **Task 3** is Facility Benchmarking. The team will visit facilities to see how they have overcome the identified problems/issues and how they "measure success". We will benchmark three regions in Africa and two in Southeast Asia. The team will visit as many facilities as possible in the destinations as practical. These facilities will include both "success stories" and "failures", and will provide lessons learned and issues that require rectification through sustainable and innovation solutions. Locations proposed are in:
- Tanzania, Kenya, Morocco, Thailand, Vientiane Lao PDR.
- Tasks 1 – 3 were the initial challenge, Tasks 4 – 8 will be forth coming once approved with GAC.

Future Tasks: Design Phase

Task 4: Modular Prototype Designs

Based on the "Successes" and "Lessons Learned" from the benchmarked facilities, Pond/AFMS will develop several modular, prototype designs. Variation in the designs would be to meet the variability in the scientific mission or goals of the Lab Operators.

Task 5: Working Prototype Design

We would like to propose working meetings at various stages of design, or possibly in the proposed site, to ensure alignment with stakeholder expectations and operational requirements.

Task 6: Prototype Construction

This would be constructed by AFMS. We propose working meetings at various stages of production at the AFMS facility in South Africa to "kick the tires" as any good working prototype should be fatigued and tested prior to deployment.

Future Tasks: Implementation & Publication

Task 7

Monitoring of the installed Working Prototype for XX months (TBD) to gather data on "measurements of success" and validate operational effectiveness.

Task 8

Publish the results (both good and bad) to inform GAC and BioPREVAIL on a path forward for the Achievement of Sustainable Laboratories. The goal is to graduate from an initiative to an implementation.

Approach and Methodology

8/7/25, 11:13 AM Zoho Survey

POND

AFMS

Laboratory Facility Survey

This Survey will be used to **identify problem areas** that have systematically proven to be a challenge in the areas of **facility maintenance and operations.**

Your responses to this Survey will remain anonymous, and your facility-specific information will not be used for publication purposes. The Survey can be conducted by several people within your organization, and we encourage you to get a cross-section of your staff to provide the best response. For instance, please share this with laboratory administrators, laboratory managers, laboratory technicians, facility maintenance engineers, and other relevant staff.

We kindly request that you take one week to complete the Survey to the best of your ability. When our team engages with you, either in-person or virtually, we can help you in completing any items where you may need or want further clarification or explanation.

For your convenience, you can use the **"Save and Continue Later"** feature, located in the upper right-hand corner, starting on page 2. This option generates a unique link that will be sent to your email, allowing you to seamlessly resume the Survey at a later time.

INFORMATION

* Name of the Main Point of Contact for the Survey

* Institution Name

Institution Location

Address

Country

https://survey.zoho.com/survey/api/v1/private/portals/886995885/departments/6EM8FV/surveys/116417400000205001/web/download/html#printBlpor... 1/41

- Pond and AFMS first developed a Facility List and contacted as many of the laboratories in the focus countries as possible. The intent was to create a valuable first hand data set of enough information based on the mission of these laboratories, as well as the institutional structure (private, semi-private, government) of these facilities.
- We developed a survey to be sent to the facilities selected to get advance information prior to the lab assessment (Benchmarking).
- We developed the Zoho survey which was used for the identified labs to complete, this created a base line of the problem identification.
- The instructions for completing the Survey requested that it should be conducted by several people within one's organization, and we encouraged the organization to get a cross-section of its staff to provide the best responses.

Facilities Visited: Southeast Asia

Our team conducted comprehensive assessments across seven facilities in Thailand and Lao PDR, evaluating biosafety infrastructure, operational challenges, and maintenance practices.

1. **National Institutes of Health**
   Department of Medical Sciences, Bangkok, Thailand
2. **Bamrasnaradura Infectious Disease Institute**
   Bangkok, Thailand
3. **MoZWE, Mahidol University**
   Monitoring and Surveillance Center for Zoonotic Diseases in Wildlife and Exotic Animals, Bangkok, Thailand
4. **Regional Reference Laboratory**
   Foot and Mouth Disease in Southeast Asia (RRL), Pakchong, Nakhonratchasima, Thailand
5. **Lao-Oxford-Mahosot Hospital-Wellcome Trust**
   Research Unit, Vientiane, Lao PDR
6. **National Center for Laboratory and Epidemiology**
   Vientiane, Lao PDR
7. **Institut Pasteur du Laos**
   Vientiane, Lao PDR

Approach:
Facilities visited

Africa

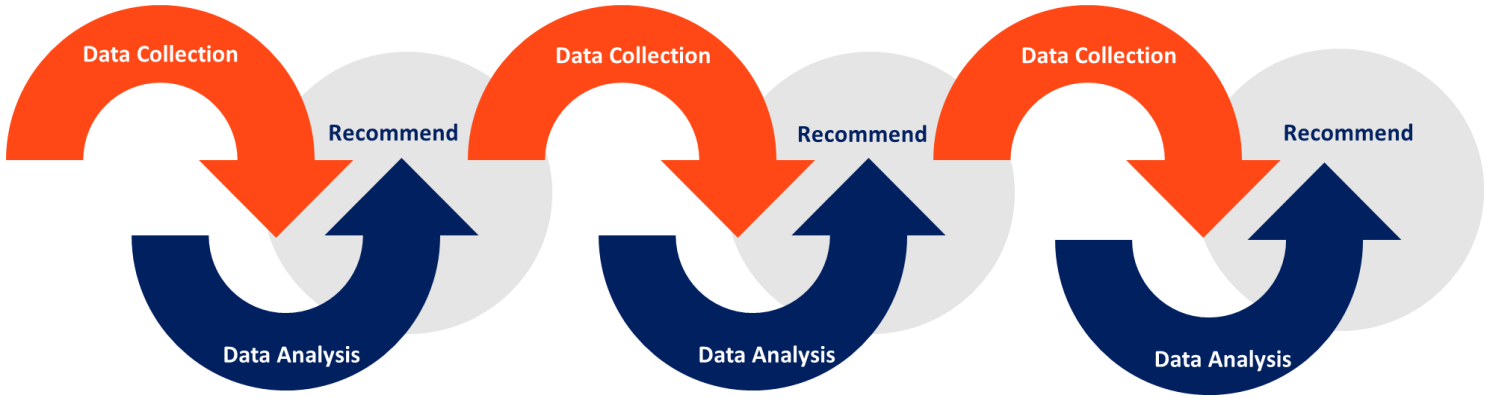
1. Kenya Central Veterinary Laboratory, Kabete, Kenya
2. National Veterinary Reference Laboratory, Embakasi, Kenya
3. National Public Health Laboratory, Nairobi, Kenya
4. International Livestock Research Institute, Nairobi, Kenya
5. National Public Health Laboratory, Dar es Salaam, Tanzania
6. Tanzania Veterinary Laboratory Authority, Dar es Salaam, Tanzania
7. Clinvet Laboratories, Mohammedia, Morocco
8. Institut Pasteur du Maroc, Casablanca, Morocco

Problem solving

We can not fix the problem if we do not know the problem – exceptionally common issues.

After reviewing all of the facilities it became very evident all the problems may be slightly different there were some very key similarities:

- Budgets
- Staff retention
- Lack of skills (Biocontainment Knowledge)
- Lack of design requirements



Findings: User Requirement Statements

The Foundation Problem

Most labs were not designed and constructed to a documented standard (WHO LBM, CDC BMBL, etc.) and therefore any interpretation of biosafety and biocontainment could not be traced through the evolution of the labs – they could not be *"measured or quantified"*.

It was apparent at the time of design for the labs that a well-structured URS (User Requirement Statement) was not developed, prior to the appointment of a professional team.

The URS is to guide the professional team (Architects and Engineers) of what the final look, feel and performance of the lab is required.

Without this foundational document, design teams lack clear direction, resulting in facilities that fail to meet operational needs and biosafety standards from day one.

Findings: Financial Challenges

Insufficient Annual Budgets

Nearly all of the labs mentioned their annual budgets were not enough to meet operational and maintenance needs.

Data Exchange Gaps

Data exchange is essential for analysis and information for decision makers, but often lacking in budget planning.

Procurement Challenges

Governmental Institutions face major challenges (time and money) for parts and repairs. Some facilities mentioned that their annual maintenance budget was 4 times less than the funds they actually needed.

Post-Construction Gaps

It is apparent that often the funds allocated for a renovation or new build exclude consideration for funds for spares and maintenance for a period after handover.

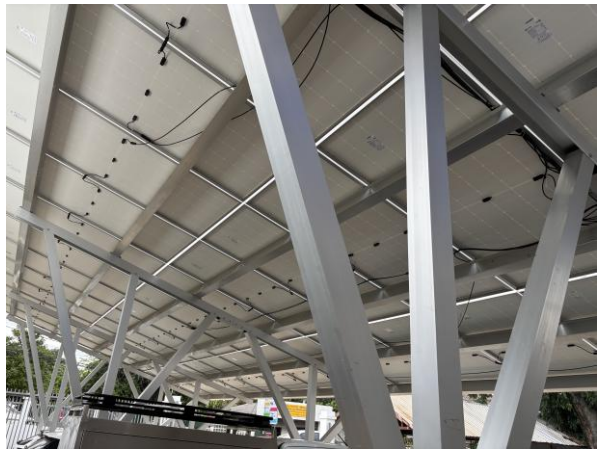
Findings – the People

- Often we see at a lot of the facilities the use of engineers and architects who's main focus is commercial buildings (hotels and offices). They are then asked to design a laboratory but have no track record of a laboratory design.
- Projects are managed by people who lack an understanding of biocontainment and biosafety and cannot provide the proper oversight of design, construction, commissioning, into operations.
- Contractors lack an understanding of biocontainment and biosafety and/or have not received proper direction from designers or project managers. Therefore the built-solution is not operational and maintainable
- This leads to very expensive mistakes that hamper the laboratories operation from hand over and more often the lab will have to be re designed and re built at a very large cost that was certainly not considered in the budget.
- Suggested peer review of all lab designs.
- Lack of higher level interest in the labs use and construction.

Findings – Right materials

- Using the right material for a lab.
- Many of the labs visited showed incorrect material used. These labs were typically labs built or renovated more than 10 years ago, we saw some of the newer labs had the right materials however were installed incorrectly.
- Designers or contractors that had "lab experience" from another industry (eg. Cleanroom or Food Production) installed equipment and components that are not suitable for a biocontainment application. HEPA filter housings are the biggest observation of this challenge.

Findings - Power



- Unstable power supplies and voltage surges
- Insufficient plug outlets
- No money to buy fuel for the generator
- Consistent power outages
- No maintenance on Generators
- Some labs were using solar collection to power systems effectively. Solar systems are readily available and scalable in all the regions benchmarked

Findings - Maintainability

- No internal maintenance staff
- Reliant on external contracting companies for basic tasks (Cleaning filters)
- Lack of in-country skills for maintenance. "Importing" maintenance is expensive and downtime can be prolonged.
- Many facilities did not have the ability to properly decontaminate equipment or filters in a safe manner.
- Many facilities did not have the capability to test the effectiveness or efficiencies of their containment systems (eg. HEPA filters)

Findings - Security

- Several laboratories lacked proper access control and separation of areas of high hazard from personal as well as the public.
- Observed some facilities were subject to theft and vandalism of equipment mounted outdoors.
- Movement of staff in areas they are not qualified or trained to work in.

Findings: Staff Retention

Human capital emerged as a critical challenge. The investment in training staff is often lost when personnel leave for better opportunities, taking institutional knowledge with them.

Salary Competition

Staff who have been trained are lost to other institutions based on needing better salaries or change in careers. The investment in their development benefits other organizations.

Knowledge Loss

Often institutions will spend money on training staff only to lose that staff member who leaves with all of the knowledge and is not replaced, creating operational gaps.

Motivation and Engagement

Keeping staff motivated to stay in their positions and enjoy their work requires ongoing investment in professional development and workplace culture.

Continuous Development

Up-skilling staff and ensuring the right person for the right job is essential for maintaining laboratory excellence and biosafety standards.

Conclusion

- User requirement statements (URS) not clearly defined of what they want. Does the program manager and end user actually know what they want and how it should work? Do they have the body of knowledge.
- Are the guidelines clearly interpreted by the architects and engineers?
- Can the program manager understand what the architects, engineers design. Can they read drawings?
- Lack of peer review of designs prior to renovation or construction.
- Right people for the right job. All too often the wrong skills sets are used that have never built or designed a lab.
- Retention of staff. All too often staff are trained and leave.

Conclusion

- Does the program manager and users understand the engineering terms used for designing a lab. Do they know the air changes?
- Can the program manager and user understand the different materials of construction.
- Budget deficits prior to construction.
- Budget deficits during construction.
- Budget deficits post hand over for maintenance and annual recertification.
- Long term view on sustainability at the out set.

World Organisation for Animal Health

Thank you

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