Assessment of the KilaKila laboratory Feb 2019

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A visit to the NARI KilaKila lab was undertaken between 13-15 Feb 2019 by Dr Bernhard Wehr and the findings and recommendations are contained in this report.Upon my arrival, I was shown the facilities by Mr Morris Oromu and Joseph Kerage and was introduced to the staff and students working in the lab. Several issues were brought to my attention by staff, or observed by myself during the visit:

Issue	Recommendation	Priority
1. The Lachat Quickchem 8500 flow injection analyser still remains unused.	Establish cause(s) why instrument does not function. Contact supplier/manufacturer to establish if software needs upgrading are if there are other causes. Find a training provider (check with DES if they can provide training)	Medium
2. A Laboratory Information and Management System (LIMS) needs to be implemented to make sample tracking easier and monitor Quality Control systems	Discuss possible LIMS with PNG providers. Check with SAFS AS and DES regarding their recommendations. LIMS speeds operations and reduces data entry errors.	High
3. The Soil and Plant analysis section of KilaKilais underutilised, it has analysed around 800 samples in the year 2018.	Obtaining accreditation will make it easier to attract more work for lab. Cost per analysis is high and may be prohibitive to some potential users.	Medium
4. More advertising or a name change may be needed to increase the profile of the laboratory and increase the workload for the lab	A name change to National Reference Laboratory, National Agricultural Chemistry Lab, or similar, may be helpful.	Low
5. The Heraeus centrifuge has no bucket/tube inserts and cannot be used. The lack of a centrifuge possibly affects the quality of results.	Check with suppliers regarding available buckets and inserts(can be done online). It is recommend that new centrifuge bottles are selected that can be used for sample extraction on the end-over-end shaker and used for the centrifuge.	High
6. The old fume hoods need replacing, new fume hoods are in storage and need to be installed.	The old fume hoods are not certified for perchloric acid digestions. The four new fumehoodsshould be installed asap. Some modification to the room or fume hoods should not be a precluding factor.	High
7. The deionised water system is unreliable and unsuitable. At the time of my visit, the system was repeatedly repaired. The quality of water is likely unsuitable to	A new water purification system needs to be acquired. Attention should be paid to the volume and quality of water required prior to acquiring a new system. For the new HPLC system, higher quality is	High

prepare standards for the ICP/AAS analyses.	required than is produced by the current system.	
8. While no power outages occurred during my visit, the new power line into the building is apparently not yet connected to the switchboard.	The power should be connected as a matter of priority. While most instruments are connected to the UPS unit, fume hoods are not and power outages will affect the ability to process samples.	High
9. Only one hotplate is available to perform acid digestions	Acquire a second hotplate, to increase capacity and to have a back-up if the old one breaks	Medium
10. Macro and micro elements are determined by AAS, not by ICP. This is a slower process, has less sensitivity and increases problems with elemental interactions (e.g. Ca-P).	Consider using ICP for macro and micronutrient analyses instead of AAS to improve sensitivity and quality of analyses and increase throughput. The higher cost for ICP is partially offset by multi-element detection capacity and higher throughput (i.e. lower labour costs).	Medium
11. Exchangeable and extractable cations in soil samples or obtained by settling of the suspensions and filtering the supernatant through filterpaper. This increases the risk is fine suspended particles interfering with the analysis.	Use centrifugation to clear the supernatant rather than filtration. This will also speed up the sample preparation.	High
12. The two wrist-action shakers are inadequate as they have only capacity for 8 samples each. Furthermore, the wrist-action shakers are not thoroughly mixing the soil-solution suspension, giving rise to unreliable results.	Replace shakers with a larger capacity end-over-end shaker. Need to replace test-tubes with screw-cap containers to minimise leakage.	High
13. Colorimetric assays for B and P rely on the UV/Vis spectrophotometer. While this instrument is working, it relies on cuvettes that need to be washed between samples. This decreases throughput.	Consider acquiring a sipper unit to speed up workflow and increase throughput. Alternatively use the LachatQuickchem FIA for large sample runs once the FIA is operational.	Low
14. The mains water supply appears unreliable. On two occasions of my visit, there was no water to the building.	Check the operation of the header tanks and take steps to secure the water supply to the lab (large tanks?). Reliability of water supply is important for the water purification system and any lab processes that rely on a water supply.	Medium

Other observations:

Record keeping is by a manual system relying in information recorded in hardbound books and on recording sheet which are filed in folders. An upgrade to a computerised LIMS system is required for traceability of analyses and results. Current record keeping appears to be satisfactory, but I suggest to use proper hardbound books rather than old diaries in the interim until a LIMS is in place. Assigning batch numbers to solutions, rather than relying on preparation dates, may also improve traceability of stock solutions.

Based on discussion with lab personnel I formed the impression that staff have a very clear understanding of the correct analytical procedures, and follow the procedures. There is a clear desire to perform excellent work, but staff are often handicapped by the unreliability of equipment. All staff were following the recommended OHS processes (enclosed shoes, labcoats, facemasks, gloves) to minimise personal risks and minimise sample contamination.

Labelling of stock solutions and working solutions is adequate, the name of labworker, date of preparation, bottle content is recorded. A LIMS will improve traceability of this information.

Lab cleanliness if satisfactory, clearly labelled and separate bench areas and cleaning baths are used for different analytical processes, minimising risk of cross contamination.

Compared to an earlier evaluation of the Kila Kila lab made Dr Ryo Fujinuma in 2017, the Kila Kila laboratory made great strides in improving their processes and most of the recommendations made by Dr Fujinuma have been acted upon.

All methods and procedures are clearly described in the lab manual. The methods of soil and plant analysis are copied from “Soil Chemical Methods- Australasia” by Rayment and Lyons published in 2011.

All soil and plant analyses are performed with internal QC samples included. The lab participates in Proficiency Testing, but results for Ca appear to be outliers (this may be due to the Ca stock solution, matrix interactions, etc).

Throughput of samples is low because methods employed are tedious (e.g. only 16 samples can be shaken at one time, the samples are filtered and not centrifuged, the Kjeldahl steam distiller can only run one sample at a time, each element is analysed by AAS, etc). Consider changing the workflow once more samples are received (better shaker, use ICP rather than AAS) and greater throughput is required.

The cost per sample is high due to low throughput and the high cost may send potential clients elsewhere. For instance, a complete soil analysis in Australia (pH, EC, org C, NH4, NO3, Cl, exchangeable cations, trace elements, B, S, texture and colour) would cost AUD100. Consider offering rebates of 10-20% when more than 100 samples are submitted at a time. When throughput is increased, the cost per sample will decrease and this will make the lab more cost-competitive.

Soil sample preparation needs to be standardised (sieve to 2 mm, crush to 2mm or use as is?). Alternatively, specify the sample preparation the client (submitter of samples) needs to perform. The finer the sample, the more homogenous it is and the better the quality of data obtained.

To ensure service standards and timeliness of analyses, it is recommenced that spare parts or backup equipment is available for all critical steps. This is of utmost importance for external clients who have an expectation of timeliness of analytical results.

For staff training, it is recommended that DES staff initially visit KilaKila and give advice on methods, procedures, workflow and record keeping and steps to take to regain accreditation and certification. Preliminary discussions with DES confirmed the willingness of DES to provide training to KilaKila. Should a LIMS be implemented, it may be worthwhile for the KilaKila lab manager to receive training in this specific software.