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Final report

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1 Acknowledgments

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Indonesian researchers (pivotal partners) developing training modules based on WIL and clear intended learning outcomes (ILOs).

2 Executive summary

The overall aim of FIS/2018/115 was to guide the development of and monitor the implementation of training and capacity building in finfish mariculture in Cambodia and evaluate the attainment of scientific capability (technical & nontechnical skills) and the professional development necessary to support viable finfish mariculture in Cambodia. The project was embedded within the South-South Triangular Cooperation (SSTC) – an ACIAR initiative between Cambodia (beneficiary partner), Indonesia (pivotal partner) and Australia (facilitating partner). The South-South project leveraged previous and ongoing ACIAR R&D investments in finfish mariculture at RICAFE Maros, South Sulawesi, and IMRAFE Gondol, Bali, to train researchers from the Department of Aquaculture Development, Fisheries Administration, Cambodia, in fish nutrition and feed development, larval rearing, and disease diagnosis.

With assistance from the SRA project team Indonesian researchers (as the pivotal partner) at RICAFE, Maros and IMCAFE, Gondol developed training modules structured around two fundamental pedagogic questions:

What is it the Cambodian researchers need to know on completion of the training, and
How will you know, they know what is needed to be known?

Each training program comprised several modules framed around key intended learning outcomes (ILOs) which included critical discipline knowledge, application and nontechnical or practitioner skills. Two cohorts were to undertake the training over a 2-year timeframe. Training was through work-integrated learning integrated into the ongoing research activities at RICAFE Maros (fish nutrition and feed development) and IMRAFE Gondol (larval rearing and disease diagnosis). Cohort 1 completed training in November 2019. However, due to travel restrictions arising from the COVID-19 pandemic, training of Cohort 2 (2020–21) trainees was undertaken using online delivery.

The evaluation of training considered the development & delivery of the curriculum and the professional development of both trainers and trainees noting particularly those processes that fostered the development of research capability and good scientific practice. A total of 17 FiA staff (6 female and 11 male) were trained to the equivalent of AQF 8 (Graduate Certificate) level. In addition to improved technical skills provided by this training, the trainees noted that the training provided them with improved non-technical skills: improved communication skills; enhanced teamwork; improved English language capability; increased professional networks. Indonesian researchers have identified that the pedagogic structuring of WIL has not only improved their practice but also kept them focussed and on task and allowed them to pivot quickly with the need to move to online delivery.

Overall, the project has demonstrated the value of well-designed training and the value of work integrated learning and clear and transparent intended learning outcomes – which help measure successful completion of the training and attainment of requisite skills.

3 Background

The ACIAR Fisheries program funded a tri-lateral project (FIS-2016-130) on South-South research cooperation, involving mariculture scientists and technicians in Indonesia training Cambodian colleagues in aspects of mariculture research. Although ACIAR has a strong emphasis on capacity-building as a component of its projects, this is the first structured approach to using a South-South cooperation approach to capacity-building in an ACIAR project. In this project the intent was for Cambodian marine aquaculture scientists and Marine Aquaculture Research and Development Centre (MARDeC) in Sihanoukville, Cambodia to undertake work-based placements in two Indonesian research facilities. The Indonesian aquaculture research institutes involved were the Research Institute for Coastal Aquaculture and Fisheries Extension (RICAFE), Maros, South Sulawesi and the Institute for Mariculture Research and Fisheries Extension (IMRAFE), Gondol, Bali. The Australian contribution was to provide support by way of training design and preparation for the Indonesian trainers and expert scientific follow-up workshops for the Cambodian early career researchers.

The SRA Evaluation (FIS/2018/115) was appended to the original South-South project (FIS/2016/130) to monitor and evaluate the training and capacity building embedded in the South -South Project.

3.1 Aims & Objectives of the SRA

The SRA Evaluation (SRA FIS 2018 -115) of the South - South Project (FIS-2016-130) complements the South -South Project in two ways. First, by facilitating and documenting teaching approaches and structures for innovative and effective south-south exchanges applicable to agricultural R&D in the Indo-Pacific region. The goal is to facilitate development of learning frameworks for innovative and effective south-south exchanges applicable to agricultural research and development in the Indo-Pacific region.

Second, from ACIAR's perspective, it is important to evaluate both the processes of training and collaboration, as well as both the individual and workplace outcomes. In this regard, enhanced professionalism and behaviours developed during the training are just as important (and often more so) than the technical learnings directly targeted by the research collaboration. Importantly, enhanced professionalism is core to strengthening institutions in ACIAR's partner countries.

FIS/2018/115 has three objectives:

1. To develop and monitor the implementation of pedagogic structure for the delivery of skills training by Indonesian scientists in the context of mariculture development in Cambodia.
2. To evaluate the degree of research and technical skills development arising from focused work-place training within a south-south framework.
3. To evaluate processes which engender increased professionalism in participants involved in south-south collaboration.

Meeting these objectives involved travel to the participating Indonesian research facilities to guide and assist Indonesian colleagues in the development of structured Work Integrated Learning (WIL) placements (undertaken in English) suitable for early career Cambodian marine science researchers. The plan was for two cohorts (each cohort a team of 3 - 4 researchers) of Cambodian researchers to undertake WIL placements at either Maros

(nutrition) or Gondol (larval rearing). Preparatory workshops were held with the Cambodian researchers to assist in their preparedness for the WIL placements and learning activities. The Cambodian researchers were also asked to self-assess their skills and capabilities as scientists. Cohort 1 successfully completed their WIL placements in 2019 and a preliminary evaluation conducted in November 2019.

Plans to refine the curriculum with the Indonesian trainers in March 2020 before the arrival of Cohort 2 Cambodian researchers were thwarted by the onset of COVID 19 and the world pandemic. After consultation with the Indonesian researchers, it was agreed to deliver the training to Cohort 2 online, necessitating pivoting the WIL based curriculum design to online delivery mode. This was an additional burden for the Indonesian trainers – with little background in online pedagogy and online curriculum design. Despite these difficulties the training was completed with good evidence to show that the intended learning outcomes have largely been met. That said, all partners in the South -South project are aligned in their view that while online training is useful and provides excellent back up resources there is immense value in well-structured WIL-experiential learning underpinned by clear intended learning outcomes.

Within this context of significant disruption, the following report outlines the achievements and impacts of the capacity building within the South -South project

3.2 Evaluation Framework

The evaluation framework comprises three components informed by comparable work undertaken in a similar international cross- cultural context (Berkvens, 2012). Specifically, the evaluation looks at several dimensions of curriculum design and delivery and at key aspects of professional development. Key data are then mapped against the three objectives of the SRA to evaluate the outputs, outcomes and impacts of the capacity building in the South-South project. Despite the interruptions and disruption created by COVID 19 there is strong evidence that all participants in the South-South project - whether the recipient, pivot or facilitating partner benefitted greatly and positive and enduring relationships created and sustained.

Data Collection

Data collection involved several key sources including surveys and interviews conducted on three occasions over the life of the South-South project. Other data sources included presentations and proposals and take-home tasks submitted by the participants, along with daily updates, What's App conversations and emails between the trainees and trainers.

As the evaluators we were present for almost all the participant presentations and many of the online lectures and lectures during the phase of online training. We also visited the Indonesian and Cambodian research facilities.

Dimensions of curriculum design

Ten dimensions of curriculum design (rationale, aims & objective, content, learning activities, teaching, materials & resources, group dynamics, location, timing, and assessment/tasks) are reviewed. The approach (see Berkvens, 2012) offers a comprehensive and useful framework to monitor and evaluate the pedagogic structure of skills training. Data pertaining to curriculum and pedagogic structure has been collected via analysis of the work-based learning modules, staff and student presentations and interviews

with the Indonesian researchers and Cambodian trainee participants. These data are summarised in Table 1, Appendix 1.

Delivery of training

The evaluation framework also considers modes of delivery noting in particular the work integrated learning approach and the adjustments made necessary by the impact of COVID 19 most particularly the transition to Online Delivery.

Levels of professional development

While curriculum design is important, the impact of the participants' professional development and shift in practice, sits at the heart of this project. The Evaluation Framework has adapted a PDA Effectiveness Model (after Guskey (2000) as cited by Berkvens (2012, 357). The focus is more explicitly on identifying the participants' learnings and reactions to the training, the application of the new knowledge and ways in which their organisation supported the learning. The evaluation addressed these criteria by reviewing the quality of participants' presentations, reviewing daily updates provided by participants, when on placement, along with presentations of applied tasks set by the Indonesian trainers. Data pertaining to professional development criteria is summarised in Table 2 Appendix 1.

3.3 Evaluation Report Structure

The evaluation report is structure around the three SRA objectives:

1. To develop and monitor the implementation of pedagogic structure for the delivery of skills training by Indonesian scientists in the context of mariculture development in Cambodia.
2. To evaluate the degree of research and technical skills development arising from focused work-place training within a south-south framework.
3. To evaluate processes which engender increased professionalism in participants involved in south-south collaboration.

Specific attention is given to identifying outputs and outcomes and key findings to contribute to the repository of what works and why in capacity building and strengthening research capability in agricultural development in developing countries.

4 Objectives, Outputs & Outcomes

The aim of the SRA project centres firmly around its objectives: to develop and monitor and to evaluate. To meet these requirements the report is organised around each objective. Each objective is organised as follows:

- The objective is outlined with relevant contextual material
- The implementation process for each objective is then considered and for each objective the approaches used to (a) develop and monitor or (b) evaluate outlined in detail.
- The evaluation and review required for each objective is then discussed and includes outputs, outcomes, and significant impacts.

The report is set out in this way to provide the reader with ready access to both the approaches adopted and the significant learnings associated with each objective.

4.1 Objective 1: Develop & Monitor Pedagogic Structure

To develop and monitor the implementation of pedagogic structure for the delivery of skills training by Indonesian scientists in the context of mariculture development in Cambodia

During the initial project development stage Dr Rimmer met with Somony Thay (Director, Dept. of Aquaculture Development), Hav Viseth (Deputy DG, Fisheries and Aquaculture) and Mam Sokdara (Director, MARDeC) to identify the technical training needs of MARDeC and DAD staff. A list was compiled (Appendix 2). The requested topics were then matched with the capabilities of the Indonesian institutions i.e., RICAFE Maros and IMRAFE Gondol. The choice of training topics was restricted by the budget that ACIAR provided (<$1m for 3 years) and after continued consultation this resulted in a focus on two major areas of capacity-building: fish nutrition and feed development, and marine finfish larval rearing. Both these research areas have been supported by several ACIAR-funded projects at RICAFE Maros and IMRAFE Gondol implemented since 1999.

Development of Training: Pedagogy & Design

Pedagogy

Key aspects of curriculum which underpinned the pedagogic structure for the training in the project included the following:

Community of Inquiry & adult learning

The training design is framed around a Community of Inquiry (CoI) approach (Archer, 2010; Garrison et al, 2000), combining a mix of teaching presence, social presence and cognitive presence and was adopted because of the emphasis on the process of social learning. It is well suited to adult learning, fostering dialogue rather than instruction – ideal for work integrated learning structured around a placement at a research facility. While a teaching presence (by local Indonesian researchers) to guide and lead has been essential, the greater emphasis has been building the participants' capacity to confirm and construct meaning (cognitive) and fostering of a range of interactions [participant with participant, participant with researcher and participants as a group], collaboration and dialogue and tasks that built capacity and problem-solving capability (Archer, 2010; Archer et al, 2000).

Work Integrated Learning

Work Integrated Learning (WIL) is the term given to learning activities that integrate academic or technical aspects of a discipline with its practical application in the workplace. The aim is to ensure that participants develop the ability to integrate their learning into work-based activities. WIL refers to a continuum of learning activities ranging from case studies to more authentic activities such as placements and real-world operations. The initial aim in the South-South project was for the Cambodian trainees to undertake authentic and well-designed WIL at the two Indonesian research facilities best aligned with the learning/ skills needs identified by Cambodia to support the development of finfish mariculture.

The Australian Qualifications Framework

Each placement (over a duration of several weeks with take home tasks to be applied/ conducted on return to Cambodia) was designed as a course/ unit/ subject comprising several modules. Given that all Cambodian trainees had completed an undergraduate degree the training units were deigned to meet the equivalent threshold standards of Level 8 (Graduate Certificate) in the Australian Qualifications Framework (AQF). This was adopted as it provided a useful benchmark for all participants and preparation for the Cambodian trainees contemplating further study.

Each course had a set of Intended Learning Outcomes (ILOs) (see below) which meet the thresholds identified in the AQF.

Training Design

Inclusive design

Conscious of the need for inclusiveness and cultural sensitivity the content, design, delivery took note of the following:

- The adoption of a *Community of Enquiry* in the curriculum design which emphasises the importance of *social learning*: learning in context, learning with peers, learning as a group or team.
- Commitment to the community was very important for the Cambodian participants and was reflected in the ILOs and in the tasks and learning activities (e.g., differing concepts of leadership).
- Specific aspects of practice and professional development that Somony Thay (Director, Dept. of Aquaculture Development), Hav Viseth (Deputy DG, Fisheries and Aquaculture) identified as essential for inclusion (e.g., understanding the scientific process, developing a proposal) – reflective of international practice & scientific conduct (Appendix 2).

Intended Learning Outcomes

Intended learning outcomes (ILOs) are the summary to the question: *On completion of the training what is it you want the participants to know?* For the design of the WIL placements, it was recommended that the ILOs focus on discipline knowledge, application, and the development of human/ practitioner skills. Generally, there are 4-6 ILOs in a unit of study. In this training design some modules focussed on particular ILOs.

Constructed Alignment & Learning Activities

Constructed alignment refers to the alignment of learning activities with the assessment (or in this training the set tasks) which in turn need to demonstrate the achievement of the Intended Learning Outcomes. The course and modules therein adopted a staged approach to learning structured across several modules. Each module usually consisted of:

- Lectures
- Demonstrations
- Experiments (both on site and take home)
- Field visits
- Daily Updates – as a version of a reflective diary.

Modular structure

- Each WIL program had an overall set of Intended Learning Outcomes (ILOs).
- The **Fish Nutrition** WIL program was initially in four modules (for Cohort 1) but for the second cohort (unable to travel because of COVID 19) modules 3 &4 were combined. For Cohort 1 studying fish nutrition each module involved a period of time spent in Maros or Barru. The length of time varied with each module and for cohort one this also involved take home tasks to be conducted in the intervening period (see Appendix 4 for an example). Cohort 2 completed the modules online and were unable to visit Barru.
- The **Larval Rearing & Fish Disease** WIL program for Cohort 1 was conducted over 6 weeks of continuous placement during which five modules were completed (see Appendix 5 for an example). For Cohort 2 this material was converted into an online program.
- Each module in both programs included Intended Learning Outcomes which included specific discipline knowledge, application, and scientific process skills as well as skills pertaining to scientific practice such as teamwork, presentation, and leadership skills.
- Both the WIL program and the Online program were structured around the same Intended Learning Outcomes (ILOs).
- For both programs there were formative tasks to be completed during the placement and take home (summative tasks – usually experiments) to be completed on return to Cambodia.

Implementation of Training

Preparatory Workshops with Participants

- In response to specific learning needs and before the participants commenced their formal training workshops were conducted to engage with the skills, capabilities and conduct expected of high performing scientists.
- The participants were also asked to self-evaluate their skills as part of this preparatory process. Throughout the training and as part of the final evaluation then asked to reflect on new skills and changes on completion of the training (see Appendix 6 for the skills checklist).
- Workshops were conducted with both cohorts and Dr Rimmer was also present. At strategic moments both Somony Thay and Dr Hav Viseth also interacted with the group

Cohort 1 & WIL Placements

- Cohort 1 – 2019 two groups of four
- One group to RICAFE (Maros) to focus on nutrition and the second group to IMCAFE (Gondol) to focus on larval rearing.

Following the first round of training (2018-19) a formal interim evaluation in November 2019, to assess whether the FiA trainees had met the Intended Learning Outcomes (ILOs) (see Appendix 3). There was also a request from FiA for an increased the emphasis on fish disease training for 2020-2021 training. An interim evaluation report was submitted to ACIAR (Fisheries Program) following this evaluation meeting.

Response to COVID 19

As identified earlier the onset of COVID 19 triggered two responses for the South-South project. First, it limited travel and Cohort 2 was unable to undertake the WIL placements and second, it resulted in a shift from face-to-face WIL placements to online training and considerable effort to design applied examples and case studies in video demonstrations and PowerPoint lectures and online training sessions. Follow up evaluation occurred in June and October 2021 and an evaluation report submitted to ACIAR.

Monitoring & Evaluation of Training Design & Delivery

This final report on the monitoring & evaluation of the training design & delivery comprises two perspectives. First, the framework adapted from Berkvens (2012) provides a succinct means to summarise the findings pertaining to the curriculum design & delivery. As previously noted, Table 1 (Appendix 1) sets out these findings and includes data on both the WIL approach and the Online approach.

Second, the ACIAR reporting methodology of distinguishing Outputs and Outcomes is also adopted as an additional means to capture other aspects of the training.

As outlined earlier the data for this evaluation has been collected through surveys, observations, presentations and updates and review of results of trials and experiments undertaken by all cohorts.

Evaluation of the Dimensions of Curriculum Design & Delivery

For both the WIL and Online delivery there was a strong and consistent mandate and rationale for both the WIL and Online training from FiA Cambodia and the Director and senior staff and researchers at RICAFE, Maros and IMCAFE, Gondol.

- All modules within the curriculum had clear ILOs which were successfully met by the participants.
- The priority content of the modules was identified by MARDeC staff and aligned with research facilities and capabilities at Maros and Gondol. For the second cohort at the request of MARDeC there was an increased focus and emphasis on fish disease.
- For Cohort 1 placed at Maros and Gondol the majority of the learning activities were work based and framed around key research skills and processes. This also included field visits and complemented by face-to-face lectures and regular daily updates on progress as a reflective activity (see Appendix 7 for an example).

- Due to COVID cohort two learning activities were a mix of online lectures and video demonstrations intermingled with applied tasks to be undertaken in Cambodia necessitating the participants to look for alternative sites for some analyses. While the online lectures, PowerPoints and presentations are a useful resource it is equally clear that WIL – particularly where English is the second (common) language - is a critical factor in learning by doing.
- The Indonesians as the pivotal partner undertook the delivery of training and role of teacher/ trainer. With the switch to online this proved an onerous task at times. While the Facilitating partner (Professor Janelle Allison) provided templates, guidance and online session and checking of online material, the depth and breadth of material to be covered was burdensome at times.
- Equipment and materials availability for participants in Cohort 2 was problematic – often not available, difficult to purchase and /or needed to be located in other local facilities.
- One of the standout features of the training (and which will also be discussed in the section of Professional Development) was the way in which the training which included ILOs on scientific conduct facilitated a better understanding of group work both within and across the cohorts. This is a particularly pleasing outcome in consolidating the idea of research teams working on research programs.
- The interview with the cohorts reveals how much Cohort 1 valued the opportunity to undertake WIL in Indonesia revealing increased cultural awareness, team building and confidence in asking questions and receiving feedback – demonstrating that the selection of the right facilities aligned to participant need was critically important.
- The feedback from Maros staff suggests that while there was a logic to four modules/ WIL placements the travel back and forth was expensive and can stall momentum. By contrast the placement at Gondol was for around 6-7 weeks with the modules embedded within that time span. The participant and researcher response suggests this is more effective.
- The participants were actively engaged in all tasks required in the curriculum. The experiments and trials were all undertaken with participants providing daily updates of their activities. This was complemented by presentations of proposals, data analysis methods & preliminary findings and results – tasks which tested that the ILOs had been met (see Appendix 9 for an example of a trainee presentation).

Outputs from Objective 1

Both Indonesia and Cambodian participants have access to a template for training design which can be adapted for internal use (see example in Appendices 4 & 5)

- Training Modules in English on Nutrition and Larval Rearing & Fish Disease developed by Indonesian researchers.
- The modules also provide a model or template for both Indonesian and Cambodian researchers to design training for other researchers, visitors to their facilities and for extension.
- The learning activities in the training modules include video clips, power point lectures, Q&A sessions along with a designated What's App 'discussion threads.
- Applied Research Experiments & Trials:
  Fish nutrition research
  - Survey of feed ingredients available in Cambodia.

- Proximate analysis of selected ingredients.
- Nutrition experiments using locally available ingredients.

Larval rearing research

- Effect of different salinities on larval growth and survival.
- Effect of different tank colours on larval growth and survival.
- Effect of water sterilisation using chlorine to reduce bacterial loads on larval growth and survival.

- Daily Updates & Reflections (foundations for reflective practice) from the participants in training – affording an opportunity for feedback from all partners and laying down the foundations for reflective practice.
- Reports by trainees on their WIL Placements in Maros and Gondol summarising their learning and tasks for completion on return to Cambodia (see Appendix 8 for an example).
- In total 17 researchers (6 females and 11 males) successfully completed the training and met the ILOs, creating a critical mass of researchers in finfish mariculture. Most training completed to AQF Level 8 standard.
- Publications & Presentations on Field Work and Experiments (e.g., Appendix 9).

Outcomes from Objective 1

For Cambodians

- All cohorts demonstrated the attainment and application of relevant discipline knowledge, technical knowledge, and knowhow (e.g., participants refer to their ability to undertake proximate analysis, or the adoption of health and safety routine as standard operating procedure).
- Alongside the attainment of relevant science and technical know how a key learning outcome was that participants better understood scientific processes and learned to adopt these processes in a systematic and rigorous manner.
- Further, this facilitated the participants' capability to apply scientific processes in other settings - with evidence the cohorts are being asked to participate in new and emerging fisheries projects (More details are in the FIS -2016-130 Report by Dr Mike Rimmer).
- All cohorts demonstrated attainment of practice and personal skills: specifically referring to teamwork, problem solving, trouble shooting.
- Demonstrated capability to set up an experiment and ask and receive feedback on these experiments.
- Demonstrated capabilities in data management including data collection and data analysis
- Presentations by participants (e.g., Appendix 9)
- Papers produced by Nutrition team (these are outline din the FIS 2016-130 report by Dr. Rimmer).
- Key evaluation questions for FiA included: Did you feel that FiA was a valued part of the project? Scale from 1 (not valued) to 10 (highly valued)'. The response was '10'. All the feedback from FiA has been very positive in regard to project design, operations, and outcome

For Indonesians

- The adoption of pedagogic structure for training, specifically the Intended Learning Outcomes provides a clear and useful template for future training.
- The Indonesian researchers also noted that the pedagogic training greatly improved their capabilities as mentors and trainers.
- The pedagogic structure facilitated the pivot to Online delivery due to the COVID 19 pandemic.
- The need to switch to Online delivery away from the immediacy of face-to-face placed significant obligations on the Indonesians as the pivotal partner. While the facilitating partners provided as much support as possible, the load of creating and delivery of material suited to online delivery was burdensome for the Indonesians when research (and not teaching) is their core business.
- One observation was that the expectations by some Indonesian project participants in regard to project research activities in the South-South project were not necessarily all met.

Benchmarks & standards

For both Indonesian participants as the pivotal partner and the Cambodian trainees as the recipient partner situating the training at Level 8 (graduate certificate equivalency) in the Australian Qualifications Framework was important. It is an internationally recognised standard providing a benchmark for both the trainer and trainee and affords an opportunity for early career researchers to identify what is required for Masters and PhD studies and builds aspiration for further study.

In recognition of this standard FiA senior staff in Cambodia have established English language training – necessary for postgraduate studies in Australia by international students.

4.2 Objective 2: Research & Technical Skills Development

The second objective of the SRA Evaluation project was:

To evaluate the degree of research and technical skills development arising from focused work-place training within a south-south framework.

Identification of Core Research & Technical Skills

At the inception meeting for the South-South Project the three participating partners developed a priority list of skills and capabilities desired by FiA and mapped against the resources and facilities of the pivotal partner, Indonesia noting where these could be complemented by the resources within the facilitating partner.

It was also noted that the training needed to have a stronger focus on scientific processes, practice, and conduct. And while the science was about Finfish (nutrition, larval rearing, and fish disease) the intended learning outcomes needed to express not only scientific knowledge but also application skills and human skills pertaining to "what constitutes a good scientist".

The participants in the training were also asked to self evaluate their skills using a Skills Check list developed in a prior ACIAR capacity building project in PNG. (Appendix 6 includes the Skills Checklist and an Example of the responses from the Cambodian trainees).

Evaluation of Research & Technical Skills Development

Data collected to evaluate the degree of research and technical skills development consisted of Daily Updates from Participants, Presentations (such as proposed trials and experiments or results and findings), conversations with participants, observation of Q&A sessions both online, What's App discussion threads as well as interviews with all cohorts and Indonesian trainers. This data was then used to evaluate success in meeting the ILOs.

Outputs

The Value of Clear Multidimensional Intended Learning Outcomes (ILOs)

Within the workshops conducted with the Indonesian researchers on the pedagogic structure of the training, there was a strong emphasis on ensuing the Intended Learning Outcomes (ILOS) reflected these scientific, technical, and nontechnical skills and capabilities.

All modules included ILOs - a strategy that has proven to be an especially effective tool to evaluate the attainment of the desired skills. Particularly so, as both cohorts participated in a preparatory workshop prior to commencing their training where they self assessed their skills (often shown to be inflated). The ILOs enabled realistic assessment of reflection on and refinement of research, technical and non-technical skills.

Outcomes

Key Findings on Research & Technical Skills Development

For Cambodians

- Attained technical knowledge and knowhow - participants refer now to their ability to undertake proximate analysis, or the adoption of health and safety routines.
- Presentations by Cambodian trainees demonstrate a capacity to structure experimental design
- Presentations by participants demonstrate they can frame a basic research proposal
- Participants can demonstrate teamwork, problem solving, trouble shooting skills
- Cohort one of the Cambodian participants actively engaged in the role of mentor
- Cambodian trainees demonstrate more confidence to ask questions

For Indonesians

- Learnt T&L skills i.e., how to deliver well structured training recognised as important given the number of visitors to their facilities and requests for training.
- Development of lecturing skills and presentations in English (opportunities for practice for Indonesian researchers)
- Structured curriculum summarised by the Gondol team as a “good systematic approach” - highlights gaps in their own materials, ensures good coverage and gives the curriculum focus
- Covid 19 fostered Indonesian researcher capacity to pivot to a blended learning model (i.e., a mix of live synchronous video/ zoom lectures and application of theory set as take-home tasks).
- Structured curriculum greatly assisted the transition to online as they knew exactly what needed to be delivered.

4.3 Objective 3: Increased professionalism

The third objective for the SRA evaluation project was:

To evaluate processes which engender increased professionalism in participants involved in south-south collaboration.

A Two Tiered Approach to Evaluation

In this section of the report, we evaluate two aspects of professional development.

First, we identify and review those processes that have proved to be especially effective in the development of research professionalism. It is also important to note that the evaluation considered not only the attainment of core discipline knowledge and capacity to apply the knowledge and undertake scientific research but also the development professional conduct and practice skills.

Second, using a framework developed by Berkvens (2012) to evaluate adult learning experiences we evaluate aspects of professional development across five key dimensions. The framework and findings are summarised in Table 2 (Appendix 1).

Data for this objective was collected through interviews and surveys, directed conversations and observations, and presentations by all partners in workshops.

Processes that engender increased professional in all participants

Outputs

In undertaking this project several processes or approaches emerged as important for building the capability and capabilities of the Cambodian researchers. Some processes such as WIL and ILOs were thought to be important from project inception, others came about because of necessity (e.g., the need to draw on local resources because of COVID restrictions) but serve as a valued lesson longer term.

Structured Training Program

All partners reinforced the value of the translating the capacity building identified at the inception meeting, into a structured program. It gave focus to all partners, enabled the pivot to online and ensured steady methodical coverage of learning.

Key pedagogical components such as adult learning and community of inquiry fostered a flexible, socially interactive learning environment that built confidence, encouraged questions and feedback. WIL on site placements foster social interaction and learning from and with each other. With the impact of COVID on travel a number of technologies such as What's App were used to try to enable similar types of social interaction, and while difficult these technologies did go some way towards fostering a community of practice.

While essential in providing the trainees with a clear and structured learning program (aligned with identified professional development needs) it is important to note that the Indonesian trainers also identified how enhancing their skills in training through authentic learning design & pedagogy has added important skills and capabilities to their portfolio as researchers who are responsible for technology transfer, extension, and mentoring. This

point was emphasised during each of the evaluation interviews and again at the final wrap up session (January 28, 2022).

Intended Learning Outcomes (ILOs)

The value of embedding ILOs in the training modules were several fold.

- First, it kept all participants (trainees and trainers) on focus especially in the switch to online and provided clarity for trainer and trainee as to expectations.
- Second, the ILOs were multi dimensional – that is meant that the training did not solely focus on discipline knowledge but ensured that application and professional conduct as a scientist were included. Thus, from the outset, for example, the ILOs included teamwork and the capacity to work in teams has emerged as a particularly meaningful achievement for the Cambodian participants.
- Finally, the ILOs require the trainer and trainee to reflect on whether the learning outcome has been achieved and thus is an effective process to evaluate learning and professional development achievements.

Work Integrated Learning

Work Integrated Learning involving placements at two Indonesian facilities is a highly effective process to foster professionalism. For the trainee they witness practice in action and for the trainer there is an obligation to perform well. WIL fosters learning by doing, builds social interaction and teamwork.

Mentoring

Several kinds of mentoring were adopted during the course of the project. A key role for the Australian partners was to provide mentoring advice to both Indonesia and Cambodian partners. Sound knowledgeable advice from good scientists in Australia such as Dr Mike Rimmer and his NSW counterparts was deeply appreciated by both trainers and trainees.

However, as the pandemic took hold and cohort two was unable to travel to Indonesia the proposal for Cohort 1 to take on a mentoring role (who had the face-to-face WIL experience) proved successful not only in fostering leadership and mentoring skills within Cohort 1 but also aiding the development of teams and teamwork.

Using what is local and near to hand

Created out of necessity because of the impact of the pandemic the need to identify local resources and facilities and problem solve emerged as an important lesson for all the partners. While it is clear that WIL and cultural exchange is a very important part of professional development it is equally important, especially in the context of aid investment to foster self reliance. The inability of either the facilitating or pivot partner to travel to Cambodia to “fix” things (only troubleshooting from afar) elevated the professional development of the trainees requiring them to build new networks and supply sources.

Team based learning

Based on the training needs identified by MARDeC at the inception meeting and the current skills and capabilities of the Cambodian trainees two cohorts were selected: one to travel to Maros the other to Gondol. From the outset it was expected they would work together. The WIL conducted in Indonesia and the design of the “Take-Home Tasks” were deliberately designed as team-based projects. While the two cohorts selected for the

second round of training were unable to travel nevertheless the set learning activities and tasks were designed to be undertaken and delivered by each team.

The value and importance of teamwork in science was a key learning outcome and the emphasis on team-based WIL and team-based presentations throughout the entire project was evident in the way in which teamwork was consistently cited by the trainees, trainers and FiA senior staff when interviewed about key learnings and achievements.

Presentations & Publications

As identified in the above point, a key aspect of the training design was the requirement of the trainees to make presentations. On completion of each module the participants were required to work as a team (teamwork was an ILO) to present processes, analyses and findings and implications. However, beyond building and reinforcing the importance of teamwork in scientific processes the regular presentation activities fostered growing confidence within the trainees - all the more so because the Indonesian trainers invited senior researchers to be present for the presentations. This was a regular occurrence and an ongoing commitment by the Indonesian trainers and Australian experts which delivered significant benefits: growing confidence by the Cambodian trainees and learning how to receive and respond to constructive feedback - absolutely critical professional skills for researchers.

Evaluation & Assessment of Professional Development

Outcomes

In the context of the aforementioned processes identified as being effective in the professional development of researchers, the framework developed by Berkvens (2012) that evaluated adult learning experiences, was also employed to further assess the nature of professional development and employment of those professional capabilities important for scientific research (see Table 2, Appendix 1).

Level of Engagement

- Enthusiastic and ongoing commitment from Cambodian trainees - even when faced with online technologies, difficulties with the internet and English.
- WIL placements enjoyed by both trainees and trainers – social interaction and discussion encouraged – evidenced in their greetings when all met in Cambodia in November 2019.
- Ongoing commitment from Indonesian trainers despite the pivot to online and subsequent preparation being burdensome and diverted attention from research – noted in the interviews with Indonesian trainers.
- Ongoing and support from senior staff in Indonesian research facilities, Australian experts, and senior FIA staff (statement/ interview with Sonomy Thay in final evaluation especially supportive).
- During 18 months of Online sessions the majority of trainers and trainees attended the sessions and remained engaged – albeit expressed concerns about speaking in English in Zoom sessions. It is noted that their confidence in speaking English improved over the duration of the project.

Participant learnings

- In addition to the attainment of specific technical skills in nutrition, larval rearing, and fish disease, Cambodian trainees emphasised their development in two particular nontechnical skills: a growing confidence in research design and application and the value of teamwork in the research
- Cambodians now more confident in developing a research proposal, conducting experiments, analysing results, and making presentations. But there is a need for more experience in working with data and seeing patterns, abnormalities etc. in data.
- Indonesian trainers emphasised the value of the design of the training material.
- Good evidence of growing willingness to ask questions and seek feedback: WIL better enables questions and feedback but use of emails and What's App enabled this to continue during the pandemic.

Self as Practitioner

- Demonstrated evidence of more confidence by trainees
- Demonstrated evidence of awareness of how to work in and with teams
- Some self awareness of individual strengths and capabilities
- An awareness of the importance of English language training
- Evidence of a shift from technician to researchers
- Some evidence of growing scientific maturing to distil findings but there is an ongoing need for more exposure to analysis and interpretation of results.
- Better understanding and improvement in employing scientific processes rather than simply carrying out technical requirements.
- Evidence of cultural awareness for those who undertook WIL placements in Indonesia.

Organisational Support

- Continuous strong support from FIA senior staff
- Continuous support from Indonesia research facilities (despite the burdensome impact of COVID 19).

Participants' Application

- Tangible evidence that the learning has been applied.
- Cambodian trainees being seconded to other emerging projects and asked to translate newly acquired skills (this deepens and enhances the learning experiences).
- All training designed by Indonesian in project included ILOs, tasks and learning activities – evidence of the use of constructed alignment in curriculum design.
- Strong support from Dr Rimmer and colleagues for the application of structured training program specifically in the embedding of pedagogy and WIL and then Online training

Secondary Beneficiaries

- Evidence that training design/ pedagogy being used by Indonesian trainers
- Demand for Cambodian researchers who underwent the trainers to lead new projects
- Evidence of demand from local fishermen because of improved outcomes in fish rearing and nutrition by researchers at MARDeC.

5 Conclusions and recommendations

Conclusions

The training program is viewed by all participating agencies as having had positive outcomes:

- It has provided increased technical knowledge in the relevant domains (larval rearing, fish nutrition, disease diagnostics).
- The trilateral model has created strong personal and professional linkages between Indonesian and Cambodian researchers strengthened by the integrated WIL approach and the interactive online activity.
- There is evidence of increased teamwork and coordination, both within MARDeC and between MARDeC and FiA DAD in Phnom Penh.
- There is evidence of increased leadership skills, particularly amongst those FiA staff nominated as mentors.
- There is ongoing transfer of knowledge and skills from trainees to other MARDeC and FiA DAD staff.

There is evidence of increasing industry engagement:

- Local fish farmers are increasingly seeking technical support from MARDeC staff.
- Farmers have requested support from MARDeC staff in making on-farm feeds to partially replace ‘trash’ fish feed for Asian seabass farming.

The pedagogic structure has been valuable

- Demonstrated value in pedagogically structured training to build scientific research skills and capabilities.
- Demonstrated value of inclusive collaboration to define the training focus, training approach and desired outcomes.
- MARDeC training needs developed in collaboration with the two best aligned Indonesian institutes
- Clear intended learning outcomes (ILOs), allowing for objective evaluation of training successes.
- The incorporation of practical and personal skills development with technical and discipline-based skills in the pedagogic design (particularly ILOs) has strengthened teamwork, confidence, and self as a scientist.
- The pedagogic structure used by the trainers transferred readily to online delivery and kept all participants focussed and on task.
- Capacity building for Indonesian researchers in design and delivery of training has equipped them to meet similar demands at their research institutes.
- Online training materials such as PowerPoint presentations and video demonstrations have provided a repository of training resources for both Cambodian and Indonesian participants.
- Online delivery is less effective than work-integrated learning (WIL) but provides useful complementary and follow-up learning resources after WIL (or placements) have been undertaken and/or completed.

- Learnings from the adoption of pedagogic structure and WIL provide a platform for future capacity building initiatives in ACIAR, Indonesia and Cambodia.

Recommendations

The gains made are fragile:

- Specifically, additional training and development is required in:
  - Leadership skills development – focusing on emerging leaders and younger early career researchers and technicians.
  - Continued technical training (fish nutrition, larval rearing, fish disease) to improve the operations of MARDeC and strengthen its role as the primary provider of mariculture technical support services in Cambodia.
  - Development of effective extension and technical support services to provide support along the Cambodian mariculture value chain.
  - Continued capacity building for Indonesian researchers in design & delivery of research training.

There is a need to continue to support the project's activities into the future. Specifically:

- Ensure continued curricula and scientific support for Indonesian trainers for the follow up research activities in Cambodia. In the short term this would be provided by the current project team, but with a succession plan in place to transition this support.
- Develop succession plans to replace the current project leaders / managers for FIS/2016/130 and FIS/2018/115 and integrate potential new project leaders from Australia by involving them (remotely) in research activities.
- In line with this, offer an online SSTC Emerging Leaders Workshop to build relationships across potential new leaders from Indonesia, Cambodia, and Australia.
- Develop a follow-on project through the ACIAR project development pathway, linking closely to the proposed SSTC Emerging Leaders Workshop.

6 References

6.1 References cited in report

Allison, J., Rathjen, J. & Angel, C. (2015-2019) **Capacity Building in National Fisheries Authority** (NFA). Annual Reports to Australian Centre for International Agricultural Research (ACIAR) and Mid Term and Final Reports to ACIAR. Edited summaries from reports may be found on the ACIAR projects web site: https://www.aciar.gov.au/Our-Research/Project-Development-and-Reporting

Archer, W. (2010) Beyond online discussions: Extending the CoI framework to entire courses, in Swan, K. & Ice, P. (eds) Special Issue on the Community of Inquiry Framework Ten years later, on ***The Internet & Higher Education***, 13 (1-2), pp69.

Australian Qualifications Framework Council (2013) Australian Qualifications Framework (AQF), Second Edition. https://www.aqf.edu.au/sites/aqf/files/aqf-2nd-edition-january-2013.pdf

Berkvens, J. (2012*)* What International Aid Organisations Can Learn From International Adult Learning: Experiences From Cambodia*,* ***The Journal of Agricultural Educational and Extension****,* 18:4,347-368)

Biggs, J. (1996) Enhancing teaching through constructive alignment, ***Higher Education***, 32: pp347-364.

Kolb, D.A. (1984) ***Experiential learning: Experience as the source of learning & development***, Englewood Cliffs, NJ: Prentice Hall.

Thorpe, M. & Gordon, J. (2012) Online learning in the workplace: a hybrid model of participation in networked, professional learning, ***Australasian Journal of Educational Technology***, 28 (8): pp1267-1282.

7 Appendixes

7.1 Appendix 1: Evaluation Criteria for Curriculum

7.1.1 Table 1: Evaluation Criteria for Curriculum (adapted from Berkvens, 2012)

Component	Component Descriptor	Data Collection Methods	Findings	Evidence	Recommendations
Rationale	*Was there a clear mandate for the intervention?*	*Interviews with senior FIA staff and staff from MARDeC.* *Interviews with pivotal partner – Indonesian researchers at RICAFE, (Maros) and IMRAFE (Gondol).* *Discussions with Dr Mike Rimmer – project leader.*	*Yes, strongly supported by ACIAR, RICAFE (Maros), IMRAFE (Gondol).* *Mandate clearly understood by the Cambodia Fisheries Ministry (FIA) and MARDeC.* *Strongly supported through SRA funding form ACIAR and positive feedback from ACIAR Fisheries Manager (Prof. Ann Fleming).*	*Evaluation Meeting attended by high level institutional representatives.* *i.e., Director General of FiA (H.E. Eng Cheasan):* *Director of IMRAFE Gondol, Mr Bambang Susanto.* *Senior academics from both RICAFE Maros and IMRAFE Gondol attended participants presentations and present at Evaluation Meetings.*	*Capacity Building with clear pedagogic structure based on WIL and clear ILOs strongly supported by the pivotal partner (Indonesia) as it provides focus, structure and useful training framework which can be applied to other training needs.*
Component	**Component Descriptor**	**Data Collection Methods**	**Findings**	**Evidence**	**Recommendations**
Aims and objectives	Overarching aim: To improve research skills, confidence, and quality of research. Specific aims: Ensure pedagogic structure of the work placement to enable learning.	Presentation of training modules by Indonesian trainers / mentors. Presentations of take-home tasks by Cambodians. Daily updates from the Cambodian teams while at	Clear, well developed learning modules for fish nutrition (RICAFE Maros) and larval rearing (IMRAFE Gondol) training. Use of case studies ensures a variety of examples of fish (e.g., rabbitfish, seabass, etc).	Attachment #: an example of PowerPoint presentation by Dr Asda Laining (RICAFE). Attachment # xx example of Module preparation by staff at IMRAFE.	Staff from both RICAFE Maros and IMRAFE Gondol had provided training before but the ILOs and the structure around this training gave more structure. Emphasise the focus is on “becoming a scientist”

	Ensure participants met intended learning outcomes in each module within the curriculum design.	the 2 research centres in Indonesia	Effective pivot to online training because of pandemic travel restrictions. Trainees gave presentations which reflected the ILOs. Training designed to align with AQF level 8 – a significant benchmark for Cambodians aspirating to undertake masters level training and doctorates.		not just the attainment of technical skills. ILOs include evidence of know-how of whole research process and important human skills required of an effective scientist.
Component	**Component Descriptor**	**Data Collection Methods**	**Findings**	**Evidence**	**Recommendations**
Content	*For each team a shared understanding of the components of each model and the scientific processes related to nutrition and larval rearing* *Small change to Gondol Personal ILOs.Some tightening of Maros ILO* *Use of curriculum design framework.* *Strengthen personal skills* *Strengthen operating standards and WHS*	*Presentations of the training delivered by the Indonesian teams* *Presentations by each of the Cambodian teams* *Review of the daily updates from each Cambodian team while in Indonesia* *Field visit to look at the trials set up by each team on return to MARDeC*	*The Gondol Team preparation and presentation was strong with many Indonesian local staff involved in the design and delivery (see presentations with numerous names list as contributors).* *The Maros Team presentations generally clear and concise.* *Nutrition Team requested more training on data analysis.* *Modules worked well but it became evident in the evaluation meeting that there is a need for one more module to draw all the learnings together.* *Pivot to online training involved the development of*	*.Attachment # 2: Sample of curriculum* *Attachment #3: Note presentations with names of Indonesian team members.* *Development of online demonstration videos.* *Regular synchronous training sessions – involving lecture, Q7A and open discussion. Some difficulties with internet and English language – but good commitment form all parties.* *Regular attendance by cohorts 1&2 to online lectures.*	*Stronger emphasis in ILOs on "soft skills" (including confidence round interpretation and judgements)* *Additional short module on the interconnectedness of scientific process* *Development of Presentations skills to include rationale/ justification and how to frame research questions* *.*

			training videos and more power point materials.		
Component	**Component Descriptor**	**Data Collection Methods**	**Findings**	**Evidence**	**Recommendations**
Learning activities	Describes the different approaches adopted in the modules to facilitate learning	The Cambodian teams began collating and sending daily updates. These updates are a good way to summarise each day and provided a forum to discuss their learnings and explain their thoughts to each other.	Use of PowerPoint in all presentations. Very positive environment with lots of opportunities for applied work. The participants were also able to learn practical skills not necessarily in a Bachelor degree (nets, tanks, drying cupboards). Use of video clips, PowerPoint synchronous lectures and Q&A for online sessions. Follow up tasks to be applied and presented to Indonesian trainers and Australian advisors.	Attachments # 4 Daily Updates sent as emails to trainers and JA and MR Attachments 1-3 Examples of Presentations	Need to expand variety of learning activities. Note the tensions of trying to balance training with research. An opportunity to develop a variety of learning activities including adoption of technologies. Event Launch Funding to assist in this process.
Component	**Component Descriptor**	**Data Collection Methods**	**Findings**	**Evidence**	**Recommendations**
Facilitator/trainer/ teacher roles	*Identify teaching approaches - what worked and what didn't.*	*Informal discussions* *Presentations* *Observations of research trails set up by Cambodian teams on return to MARDeC* *JA sat in on presentations and lectures.* *Evaluation survey and interviews*	*Lots of questions asked.* *Senior and junior staff present at presentations by Cambodian teams.* *Indonesian researchers took the planning and delivery of the modules very seriously.* *Good positive relationships formed.* *Extraordinary commitment by Indonesian trainers to development of online materials during the COVID 19 pandemic. Above and*	*Larval rearing team did presentations to Senior Staff. They were able to practise with junior researchers first.* *Evidence of trust in lecturers (i.e., contact with problems and questions).* *Good relationships formed with local staff.* *Note: "peer learning approach"* *Evidence of networking – seeking advice.* *The relationships between the two sets of researchers was very good and was evident when they greeted each other.*	*Cambodian participants were forced to identify and negotiate use of or access to local resources or facilities because they were unable to travel to Indonesia for WIL. This proved to be effective in building confidence and capacity to problem solve.* *It is recommended access to and sue of local resources be encouraged in further training.*

			beyond their usual duties and responsibilities.	*Cohort 1 took on a role as mentor for Cohort 2 who was unable to travel to Maros or Gondol due to the pandemic.*	
Component	**Component Descriptor**	**Data Collection Methods**	**Findings**	**Evidence**	**Recommendations**
Materials	Availability of equipment materials needed for each training module.	Informal discussions with both Indonesians and Cambodians. Visits to both research centres in Indonesia Inspection of labs and field trials at MARDeC	Satisfactory access to materials and equipment at both Indonesian research centres. Purchase of equipment for feed/ nutrition research in MARDeC Purchase of tanks and associated equipment for larval rearing trials at MARDeC . Some difficulties encountered with supply chains and access to materials during the COVID lockdowns.	Attachment # 7: Local Nutrition lab/ facilities MARDeC Attachment # 8: Larval Rearing Trial MARDeC .	Need for more work on layout and structure of Nutrition Lab. Note point made in above section.
Component	**Component Descriptor**	**Data Collection Methods**	**Findings**	**Evidence**	**Recommendations**
Grouping	*Composition and dynamics of the groups*	*Informal group discussion with both Cambodian teams* *Observation*	*Strong emphasis on teamwork.* *Evidence of different learning styles.* *Group was positive about group dynamic.* *Participants were able to identify who brought which skills to the group.*	*Feedback from groups as well as individuals*	*Include additional ILOs to consider roles, responsibilities, and group dynamics in research teams* *Cohort One to mentor and peer support to Cohort Two* *Use the Reflective Learning Cycle: ensure discussions at night include this process and daily reports include ALL team members' ideas … it is a team effort.*

Component	Component Descriptor	Data Collection Methods	Findings	Evidence	Recommendations
Location	Effectiveness of the placement into research facilities	Observation Informal discussions Site visits	Structured and well-designed WIL /placements work well. The Baru 3- week placement (research facility attached to Maros) was a highlight for the students. Some impact on Indonesians having the participants at their research facilities for extended periods.	Because Cohort 1 undertook WIL in Indonesia, and this was not available for Cohort 1 it is possible to note some differences in the level and quality of training.	Adopted well designed WIL based training with clear ILOs.
Component	**Component Descriptor**	**Data Collection Methods**	**Findings**	**Evidence**	**Recommendations**
Time (timing)	*Effectiveness of the delivery model: modular learning combined with hands on practise.*	*Review of research trials* *Observation* *Informal discussions*	*Both placements were of a suitable length.* *Cost re: modules back and forth were not budgeted for and may need to be considered.*		*In biological research need to be flexible. Suggestions to concentrate statistics/data into 1 week.*
Component	**Component Descriptor**	**Data Collection Methods**	**Findings**	**Evidence**	**Recommendations**
Assessment	Did the tasks sufficiently test that the ILOs had been met? Were the tasks replicated in actual daily work? i.e., applied in the workplace.	Presentations by each of the Cambodian teams Site visits to research trials set up by both Cambodian teams	Excellent strategy at Maros of "take home" assessment tasks. Evidence in the masterclass presentations of the capacity to extract out learnings of relevance to local research at MARDeC	Presentations checked against ILOs suggest basically met. Effectiveness showed up in asking for significant moments. Attachment # 9: Presentations by each team from Masterclass workshop	Continue with take home tasks as an excellent means to assess the effectiveness of applying the skills and knowledge.

7.1.2 Table 2: Evaluation of the Researchers' Professional Development

This evaluation tool will have a specific focus on identifying participants' learnings across research design, research process and application in actual daily work i.e. *Is there a discernible improvement in the participants' research practise?*

*(*adapted from Berkvens, Jan (2012*)* "What International Aid Organisations Can Learn From International Adult Learning: Experiences From Cambodia*", The Journal of Agricultural Educational and Extension, 18:4,347-368)*

Components	**Descriptor**	**Methods**	**Findings**	**Evidence**	**Recommendations**
Participant engagement	*Participant s' reactions to the work- based learning & south-south delivery model*	*Observations, informal discussion and student and researcher feedback.* *Interviews with Cohorts 1 & 2. Interviews with trainers and senior FIA staff.*	*Enthusiastic – seeking to learn and positive attitude.*	*Good presentations.* *Good social relations between trainees and trainers (especially cohort 1 linked to WIL).* *Regular updates from both cohorts.* *Use of What's App to maintain regular contact.*	*Tri-lateral learning approach and structured training program is well received.* *WIL/ Placements at external research facilities makes a significant impact.* *English language often a barrier but marked improvement in use by Cambodians.*
Components	**Descriptor**	**Methods**	**Findings**	**Evidence**	**Recommendations**
Participant learnings	Participants demonstrate shared understanding of the material presentation and capacity to use skills and apply knowledge Participants' articulate significant learning moments.	Observations, informal discussion and student and researcher feedback. Daily updates from Cambodian teams. Survey questions in evaluation interviews with cohorts 1 & 2 and with trainers and senior FIA staff.	Ranged from process (daily updates) to specific "ah ha" moments (i.e., fish disinfection e.g., use of iodine). Evident in proposals and experimental trial design proposed and sent to Indonesian trainers and Australian advisors for feedback. Feedback adopted. Evident in presentations by Cohorts and Cohort 2. Evident in the questions asked via What's App.	Participants self-identified skills improved were: English Technical/reading skills -Working as a Team: understanding the necessity to work as an integrated/supportive group of scientists. -Use of equipment and trial of different techniques. -Design of experiments -Statistical & Calculation techniques	English language skills were a significant issue for some participants. The participants have gained more confidence but have indicated they would appreciate more practise. (Baru was highlighted as a very good facility to do this. The value of the field work further highlighted by the difference in experiences/ WIL when Cohort 2 unable to travel.

			Evident in papers/ reports sent to Indonesian trainers and Australian advisors for feedback.		
Components	**Descriptor**	**Methods**	**Findings**	**Evidence**	**Recommendations**
Self as Practitioner	*Demonstrated evidence of research practise including:* *-Tangible evidence learnings have been applied (at macro and micro levels)* *-Awareness of the research and data cycle* *-Capacity to work as research teams* *Evidence of self-awareness of roles & responsibility in the research process*	*Observation* *Informal group discussions* *Site visit and inspection of field trials & research experiments (Cohort1, 2019)* *Survey of Cohorts 1 & 2 and interviews with Indonesian trainers and Dr. Mike Rimmer.*	*Strengthened technical skills and a discernible shift from technician to researcher* *Evidence of better understanding of scientific processes e.g., trial design. Skill attained but now needs practice.* *Evidence of capacity to work in teams.* *Evidence of greater confidence.* *Evidence of capacity to apply new knowledge in other settings.*	*Evidence of capacity to "distil" learnings from masterclass* *Experiments replicated at MARDeC.* *Current and failed experiment design and capacity to adjust and restart field trials.* *Improved presentations and use of data and data analysis.*	*Stronger focus on the research process and justification and context for research.* *Need for additional training on analysis and interpretation.* *Need for additional training on leadership & management.* *Need for more practice/ experience in making judgement calls and assembling evidence to support claims.* *Suggest a stronger focus on confidence to make a judgement in future training and ILOs.*
Components	**Descriptor**	**Methods**	**Findings**	**Evidence**	**Recommendations**
Secondary beneficiaries	Learnings for the participants that were unexpected. This component will also look for flow-on benefits and effects.	Informal conversations	Indonesian teams plan to use the pedagogic structure for other training. Cambodian teams asked to transfer their new knowledge to other projects.	Other agencies have approached MARDeC for opportunities to involve trainees in new projects. Local fishermen keen to access findings on fish feed ingredients. Improved survival rates in larval rearing results in access to local fingerlings resource for local fishermen.	

7.2 Appendix 2: Summary of notes from collaborative inception meeting to determine training needs

MARDeC 17th November: Collaborative meeting by all partners to determine the key learning needs.

Seed Production Division

Research techniques in seed production

Brood stock management, including genetic aspects

Larval rearing – good survival and healthy fingerlings

New and innovative technologies – e.g., biofloc, recirc. systems

Reading material for biology, brood stock management, larval rearing, etc. (hatchery manuals) – background in theory – also for the university sector

Linking research activities to impacts

Larviculture training – particularly to stabilise live feed production

Identification of copepods – isolation and culture of local copepod strain.

Analysis of live feeds to compare e.g., *Artemia* and copepods

Microalgae production unreliable – how to improve? Hot temperatures – poor survival / production.

Identify local phytoplankton – isolation and culture.

Environment related to survival and growth

Research on fish physiology / environmental effects on growth and survival in grow-out

Water quality for mariculture – basic knowledge and training (inc. sampling and analysis of parameters)

Fish Nutrition

Feed formulation

Analyse – proximate composition

How to conduct experiments

Fish Disease

Biosecurity approaches.

Identify pathogens – parasites, virus (PCR).

Bacterial culture and counting.

How to sample (bacteriology and virology).

Prevention of disease.

Disease treatment.

Histology and pathology analyses. Reading histo slides.

Research & Publication

Experimental design – general.

Writing papers for journal publication – journal requirements

How to find the appropriate journal

Senior Staff Support

Visit to successful mariculture operations in Indonesia to see how mariculture is done – transfer to Cambodia.

Exposure to effective management of research institutes, sustainability of research institutes.

Initial Project Meeting – Preparatory Training

Workshop on fish nutrition – Crawford Fund Masterclass material.

Workshop on larval rearing – Mike and Stewart to develop.

7.3 Appendix 3: Evaluation and Baseline Report (Nov 2019)

REPORT 1: Evaluating processes and outcomes in south-south research collaboration – finfish mariculture development in Cambodia through cooperation with Indonesia.

The ACIAR Fisheries Program has funded a project (FIS-2016-130) on south-south research cooperation, involving mariculture scientists and technicians in Indonesia training Cambodian colleagues in aspects of mariculture research. This small research activity (SRA) project complements project FIS-2016-130 by facilitating and documenting teaching approaches and structures for innovative and effective south-south exchanges applicable to agricultural R&D in the Indo-Pacific region.

A specific focus on south-south collaboration as an R&D process is novel for ACIAR, but will be increasingly employed by ACIAR and the Australian Official Development Assistance (ODA) program. From ACIAR's perspective, it is important to evaluate both the processes of training and collaboration, as well as both the individual and workplace outcomes. In this regard, we recognise that enhanced professionalism and behaviours developed during the training are just as important (and often more so) than the technical learnings directly targeted by the research collaboration. Importantly, enhanced professionalism is core to strengthening institutions in our partner countries.

Mariculture research stations involved in Indonesia are the Research Institute for Coastal Aquaculture and Fisheries Extension (RICAFE), Maros, South Sulawesi and the Institute for Mariculture Research And Fisheries Extension (IMRAFE), Gondol, Bali. In Cambodia it is the Marine Aquaculture Research and Development Centre (MARDeC) in Sihanoukoukville.

The goal of the project is to facilitate development of structures for innovative and effective south-south exchanges applicable to agricultural research and development in the Indo-Pacific region.

The project has three objectives:

4. To develop pedagogic structure for the delivery of skills training by Indonesian scientists in the context of mariculture development in Cambodia.
5. To evaluate the degree of research and technical skills development arising from focused work-place training within a south-south framework.
6. To evaluate processes which engender increased professionalism in participants involved in south-south collaboration.

First Report: Training design & structure and Baseline evaluation

This report is the first of three to be generated over the next two years. As an initial report it will outline the development with Indonesian scientists of the training curriculum for the work integrated placements undertaken by Cambodian scientists at either RICAFE Maros or IMRAFE Gondol.

This report will also provide a baseline account and evaluation of the skills and capabilities of the first cohort of Cambodian participants in FIS/2016/130. It is envisaged that there will be at least 2 cohorts who will undertake placements at RICAFE Maros and IMRAFE Gondol. Those participants placed at RICAFE Maros will focus on marine finfish nutrition research while those at IMRAFE Gondol will focus on marine finfish larval rearing research.

As the baseline report it will comprise:

- Methods for data collection and evaluation
- Itinerary
- Discussion of outputs and outcomes for RICAFE Maros and IMRAFE Gondol
- Discussion of work with Cambodian participants
- Recommendations and follow up actions

Methods

The data collection for this first stage of the SRA project comprised the following:

- Field visits while at Maros, Gondol and Phnom Penh and Sihanoukville (MARDeC) including a visit to a small-scale fish farm en route to MARDeC
- Discussions and semi-structured interviews with scientists and technicians at RICAFE Maros and IMRAFE Gondol involved in training the Cambodian scientists
- Discussions with senior staff in the Fisheries Administration's Department of Aquaculture Development in Cambodia
- Discussions and semi-structured interviews with all the participants in the first round of work-integrated learning (WIL) placements
- Skills audit of the Cambodian participants
- Secondary material comprising the handouts, protocols and materials prepared by the Indonesians for the Cambodian participants' first visit.

Itinerary

The visit to the Indonesian facilities and to Cambodia (Phnom Penh & Sihanoukville) took place from 3rd February to 25th February – with 1 week each at Maros and Gondol and 10 days in Cambodia. This first evaluation and baseline visit followed the planning meeting for the South – South Project and an initial placement experience by the Cambodian scientists at RICAFE Maros or IMRAFE Gondol. While not originally planned in this way it turned out to be very effective, in that the Indonesians were now much more conscious of the need for a well-structured and designed placement and the Cambodians could provide useful feedback on their initial training experience. This was especially important as the common language for the training was English – with varying levels of proficiency.

<u>Week 1 – Maros (Makassar)</u>

- Weekend flights to Indonesia
- Monday – preliminary meetings and discussion; visit to all labs used for the training and feedback on the first visit
- Tuesday – Chinese New Year – a public holiday in Indonesia (worked on project preparation)
- Wednesday – Thursday – training with Maros team (around 15) on how to design and structure training curriculum
- Friday visit to Buru facility (floating net cages, tanks and ponds plus accommodation and training room and useful spaces).

<u>Week 2 – Gondol, Bali</u>

- Weekend flights to Bali (4-hour drive to NW Bali, Gondol facility).
- Monday – Formal welcome, overview of Gondol, meeting with all scientists, discussions on first visit by Cambodians
- Tuesday – field visit to all Gondol facilities
- Wednesday – Thursday training workshop – around 20 scientists & technicians.

- Friday – return drive to Denpasar for weekend flights to Phnom Penh

Week 3: Phnom Penh & Sihanoukville

- Monday – formal welcome by FiA staff; commencement of semi structured interviews with Cambodian participants regarding their initial placement, background qualifications & experience, career aspirations and skills self-assessment.
- Tuesday – continued semi structured interviews
- Wednesday – follow up discussions and feedback for Cambodians on their "take home" applied projects following first visit to Maros or Gondol.
- Thursday – Friday – workshop with Cambodian participants (Self as Scientist) including skills audit
- Saturday – Sunday visit to MARDeC to review site, the facilities, equipment needs for participants to undertake applied research projects on return from Indonesia. This visit also included a visit to a small fish farm and some observations regarding extension roles of scientists.

1. WIL Training Design & Development (Maros & Gondol)

The workshops conducted with staff at RICAFE Maros and IMRAFE Gondol took the same format. The workshop comprised the following components:

- Introduction to **Australian Quality and Standards** and the Indonesian equivalence. This was provided to show the Indonesians that the training was being designed at Graduate Certificate level (8) which follows a Bachelor qualification (level 7) and thus a logical next step and building block (pathway) in the development of research skills and capabilities.

- **Types of knowledge**: the Indonesian scientists were asked to identify the kinds of skills they felt were essential for good science and scientific practice (this was done as a group brainstorming exercise in both sites). After this process these skills were then grouped as Scientific or Discipline skills, Applied Skills and Personal Skills. What is interesting, is that similar to PNG and work with Australian Scientists, personal skills predominate – albeit often tertiary courses don't "teach" any of these skills (but rather expect they are "learned" along the way. From this training program the Indonesians were encouraged to design curriculum that addressed each skill type.

- **Curriculum design format and structure** including:
  - Structuring and role of Intended Learning Outcomes (ILOs) – "what is it you want them to know at the end of this course"
  - Structuring and role of "assessment" or follow up tasks including formative tasks while in Indonesia and a summative "take home" task for application in Cambodia;
  - Learning activities – with a particular emphasis on applied learning activities and a diversity of learning experiences (i.e. not too many lectures and power points) and to include field visits, presentations and case studies.

- Development of **WIL Training Modules for the Placement** (6-8 weeks) with ILOs, Assessment Tasks and Learning Activities for each Module (outlined for Maros and Gondol below). The scientists in Maros and Gondol were asked to identify overall ILOs for each placement (Nutrition and Larval Rearing) and then within that consider how best to deliver material – a series of connected topic modules seemed the best

way forward. Teams were allocated to each module and asked to design "their "module accordingly.

1.1 RICAFE Maros Training Outputs – Nutrition WIL Design & Structure

Upon review of the desired overall learning outcomes and learning from the first visit by Cambodians to Maros and the status of their capability the Nutrition team at Maros designed their WIL as three separate modules each with a take home task - the results of which are input for the next module. The Nutrition WIL Placement is structured as follows:

- *Module 1(2 weeks @ Maros*): – Understanding and Analysis of Feed Ingredients
  Includes introduction to proximate analysis techniques and identification of local ingredients for aquafeeds.
  Take Home task: Take-home task: survey of local feed ingredients available in Cambodia; preparation of samples for analysis at RIcAFE Maros as part of Module 2 and preparation of a Report on Analysis of Local Ingredients

- *Module 2 (4 weeks @ Maros)*: Analysis of local (Cambodian) ingredients, feed formulae, development of feed types, evaluation of feed types (experimental design and feed trials), data collection
  Take Home task: Experimental Design and Feed Trial – data into excel spreadsheets for analysis

- *Module 3 (2 weeks @ Maros)*: Descriptive and statistical analysis of results and interpretation
  Take Home task: Presentation & Communication of Findings

- *Module 4 (1 week @ Cambodia)*: Presentation – Indonesians (and ACIAR and Australian staff) to visit for presentation

1.2 Gondol Training Outputs – Larval Rearing WIL Design & Structure

When reviewing the desired learning outcomes of this placement experience the Gondol team also opted for a module structure – but designed as a series of 5 interconnected modules to be completed over a 5-6-week period. This is designed to cover a typical larval rearing cycle, which is about 30 days for Asian seabass / barramundi and about 50 days for grouper. The team opted for this approach as they felt that it was important to see larval rearing as a complete process and that each of the steps (modules) contributed to the success of the process. That said each module was designed to include specific ILOs, applied tasks and different learning activities appropriate for the material/ learning to be covered.

The Larval Rearing WIL Placement is structured as follows:

- Brood stock and egg collection
- Live feed
- Larval rearing
- Water quality
- Disease management

As stated each of these modules will include specific intended learning outcomes and formative applied assessment type tasks. Gondol staff have been encouraged to offer a

variety of learning activities as this enables the participants to learn through a number of perspectives and approaches.

1.3 A note on the Design approach

The approach used to design and structure the training modules is based on Australian curriculum design processes, and thus is an example of currently-accepted best practice being applied in Indonesia. It should be noted that Indonesian tertiary education institutions have adopted / are in the process of adopting similar approaches for curriculum design.

Essentially designing curriculum is a three-step process which begins by, in effect, asking the question “What is it you want the participants to know on completion of this training?”. These are the **intended learning outcomes**. This is followed by a question which pertains to **assessment tasks** which answers the question: “how will you know they know what it is intended they learn”. This second step then determines the **types and array of learning activities** to be undertaken.

This approach was adopted as it is accepted curriculum design practice and adopted in most tertiary education settings. The nature of the ILOs, assessment tasks and learning activities will then change as the level of qualification rises. For this project, the curriculum was informed by the Australian Qualifications Framework which outlines the levels of thinking skills needed across a spectrum from Certificate 1 (Level 1) to PhD (level 10). For each level, the order of thinking skills becomes more complex, such that by level 8 (graduate certificate) for example there is an expectation of analysing, evaluating and creativity in thinking skills. This is expressed in the ILOs, assessment tasks and developed through a range of learning activities.

For this project the training was developed at level 8 for two reasons. First, most participants hold a bachelor’s degree in fisheries science, second it is a logical building block and preparation for a master’s degree qualification and offers consistency for any opportunities for credit or recognition of prior learning.

1.4 Response and uptake

The response from the Indonesian scientists was very good. They not only grasped the basic design and structure concepts but also could immediately see application to other training they may wish to offer.

From the training perspective what was especially pleasing was the use of “learning oriented language” by the end of the workshop. For example, when asked to present their module structure many of the Indonesian scientists were able to introduce their module using the phrase “on completion of this module participants will be able to…”.

That said, it is also important to note that while not adopting a curriculum design structure for the first visit to Maros and Gondol by the Cambodians the Indonesians had nevertheless sought to prepare material. These materials included an outline of protocols for the use of equipment as well as background material on feed ingredients and processes for preparing pellet feed etc.

These materials will be included in a **training manual** to be prepared for the Cambodians which also includes ILOs, assessment tasks, timetable of learning activities for each module as well as readings and other preparatory material.

1.5 Issues

Delivering training in English to participants for whom English is a second language is often difficult. For the most part most Indonesians had sufficient English to participate fully in the

workshop. Several technical staff were (rightly) included in the workshop as they play a critical role in demonstrating methods and equipment – but this did pose some issues in regard to language and translation. This also was a point raised in relation to their interactions with the Cambodians.

The other issue was in finding ways for the participating Indonesian researchers to think more widely in regard to training learning activities. In the initial visit there was a heavy reliance on demonstration of methods, PowerPoint and lecture formats. Indonesian researchers were encouraged to widen the variety of activities to include ideas such case studies, field visits, video clips, YouTube type presentations, apps etc. as YouTube and videos have the benefit of supporting English language learning and comprehension and have the benefit of being viewed multiple times.

A recommendation will be to apply for Launch funds to afford the Indonesians an opportunity to learn more about learning activities especially in the use of newer technologies for teaching.

1.6 Recommendations for Indonesian participants

The evidence, based on participation and engagement, is that the training in the design and development of training particularly WIL/ applied training was not only timely but also well received.

What is critical is that the Indonesian trainers need more practice and access to more “know how” in the designing of learning activities.

- It is recommended that three staff in each research facility are afforded an opportunity to learn more.
- It is proposed to develop a 2-day workshop, to be held in Australia, on advanced learning and teaching methods including the use of digital technologies.
- There is not sufficient budget in either the south-south collaboration project (FIS/2016/130) nor the SRA project to support this activity. An application will be made via ACIAR’s Launch Fund for support.

1. BASELINE EVALUATION – CAMBODIA

A key goal of this project is to monitor and evaluate the building of scientific capability within ACIAR partner countries (in this case Indonesia and Cambodia). Within this remit a key responsibility for ACIAR in collaboration with partner countries is to deliver training and capacity building that supports research for development in marine aquaculture.

This process will be aided by the Work Integrated Learning placements by and experiential learning with Cambodian scientists in either Maros or Gondol.

2.1 Evaluation data

For the baseline evaluation the following methods were employed:

- An interview with each of the first cohort of Cambodians undertaking the placement;
- A post first visit follow-up interview
- Field visit to MARDeC and small fish farming enterprise and,
- A workshop focussed on skills and skills development

<u>Interviews</u>

All of the Cambodian participants plus their immediate supervisors were approached to participate in a semi structured interview. In the first instance participants were asked basic

questions about their prior education, participation in short courses and about their career aspirations. They were also asked questions about what they saw as core research skills and to consider their strengths and weaknesses.

Given that these participants had already experienced an initial visit to either RICAFE Maros or IMRAFE Gondol they were also asked for feedback on the experience.

Two supervisors were interviewed broad open-ended questions about scientific endeavour, what constitutes good science and scientific skills as well as an assessment of what was needed to lift the capacity of mariculture research and extension in Cambodia.

Dr Mike Rimmer was present during all interviews.

Workshop input, participation and & reflection

The participants were highly engaged in the workshop.

The workshop was designed to have quite a number of interactive activities – as much as to break the ice and deal with English language issues. Broadly the workshop was framed around the theme of “first self and then others”. That is the need to know one’s self as a scientist and then to understand that science involves considerable team work and working with others.

The workshop was run over two days. Participants have been asked to keep a learning journal for the period of their placement and use some of the tools and concepts introduced in the workshop to inform their journal entries and reflections.

For many of these sessions there were exercises or activities where the participants were asked to share or present. Overall while hesitant about their English they did well.

For Day 1 the focus was:

- The other side of the card – that is beyond your job what else do you bring to work (talents, attitude and values)
- Self as Scientists – skills needed by scientists and skills checklist and self-assessment
- The reflective practitioner and action learning cycle,
- Exercising leadership – leadership at all levels, types of leaderships, attributes of great leaders.

For Day 2 the focus was:

- Review and discussion on learnings from Day 1.
- Leadership & management
- The Data Management Cycle – participants were asked to translate their current projects to the data management cycle. One participant asked to share her example – which was executed very well.
- Ethics, biosecurity and WHS Community engagement, Audiences and presentation

In the following sections the basic baseline data is summarised.

Further insights through the application of knowledge

A key part of the South-South project is that the participants not only have the placement experience but also are expected to then apply these learnings on return to Cambodia. Both teams (Nutrition and Larval Rearing) were given tasks.

Both teams were asked to present their work where Dr Rimmer (and Professor Allison) were able to give feedback. The teams were asked to revise their project proposals preparation for further discussion during the field trip to MARDeC.

Nutrition Team

The nutrition team were asked to undertake a review of local ingredients and compile a report. In addition, samples of the selected ingredients were to be assembled to take back to Maros for proximate analysis – as part of Module 2 training.

All this has been completed. Dr Rimmer has reviewed the report compiled by the nutrition team and has encouraged the team to use the report as the basis for an article to be published in a well-regarded aquaculture magazine.

This is an excellent achievement and one I have recommended be written into the ILOs and Assessment Tasks for Module 1 in Nutrition. It is a tangible output and an excellent learning outcome. It also demonstrates that the team work required of the South - South project is working well.

Larval rearing team

The larval rearing team were asked to develop a basic experimental design relevant to larval rearing. They have developed a proposal looking into the effects of salinity. During the field visit to MARDeC Dr Rimmer and Professor Allison asked to be shown where and how the experiment would be conducted. This involved discussion around tank size, design, replicates, sampling etc.

The team were then asked to not only revise their experimental design but also prepare a matrix of costings associated with the experiment, since additional equipment will need to purchased using the FiA budget for FIS/2016/130. It was felt this was also an important aspect of their skills development.

Targeting of specific topics for skills development

Alongside the SRA workshop activity, the South-South team have sought where appropriate to provide targeted input in relation to a specific topic or scientific process. This can occur spontaneously (e.g. when Cambodian participants presented work on their project Dr Rimmer spent time demonstrating block sampling) or delivered as timely input (e.g. chemistry) upon commencement of a process. The Cambodian participants found the *targeting of topic specific learning opportunities* both timely and helpful. It would be useful to continue this and where possible Australian and Indonesian experts offer this mentoring activity to augment or enhance the placement

2.2 Establishing a baseline profile

Personnel profile

In total 8 Cambodians undertook the first visit to RICAFE Maros or IMRAFE Gondol. Of these 7 were interviewed in Phnom Penh, the remaining participant is presently in the Philippines. Of the 7 interviewed the following profile data is noted:

- 2 are female.
- All participants are aged between 25 and 32.
- 3 are graduates from the Royal National Agricultural University holding a 4-year bachelor’s degree
- 3 hold a Bachelor from another university; one from Thailand

- 1 holds an Associate Degree from a Provincial Agricultural College (and is working towards a Bachelor Qualification).
- All the participants had undertaken several short courses either in China or Thailand or Singapore. All had visited Wuxi in China. None of these short courses were for credit and most were not "applied".
- Of those with a bachelor's degree all had undertaken a research project in their 4th year. Most understood the basic research process as a result of that 4th year project.

Skills profile

As part of the evaluation process the participants were asked to review a skills checklist (attached Appendix 1). This skills checklist was developed by Dr Joy Rathjen and is based on findings from the skills audit conducted with staff from the National Fisheries Authority (NFA) in PNG as part of an ACIAR funded capacity building project with NFA. Essentially the skills checklist is grouped into 4 categories of skills (note these categories are similar to the list developed when brainstorming required skills with the Indonesians). These categories are: Personal Skills, Experimental Design Skills, Data Management Skills, Communication Skills.

As the checklist shows, participants were asked to self-assess as to whether they felt their skills were well developed, developed, present, poorly developed, never thought about it. Of the 7 participants who were asked to self-assess their skills:

- Two candidates felt that their skills were developed across all categories.
- The remaining five felt that their personal skills were developed, specifically those skills relating to curiosity, committed, keen to learn etc. This was certainly borne out in the workshop.
- Of the remaining 5 participants most generally felt their skills were either present or poorly developed across the other categories of skills.
- In the case of experimental design, it was clear that in regard to the more technical aspects of experimental design and research most felt they had much to learn.
- In regard to data management the participants felt they understood aspects such as confidentiality but knew less about data collection (and methods), data recording and data analysis.
- Most participants felt they had basic communication skills in that they were able to interact but felt they were poorly developed in regard to structure, organisation of results and presentations.

Summary of baseline evaluation

As has been outlined in the South -South project proposal there is a critical need to upgrade the capacity of and capability within marine aquaculture research in Cambodia. Several key points are made:

- The evidence shows sound basic skills and an enthusiastic willingness to learn.
- Framing research questions remains an issue.
- The application of methods to research questions and problem-solving needs further development.
- Data analysis, synthesis and interpretation need further development as do presentation methods and skills.
- Most participants grasp specific methods quickly (and presently have JICA staff to assist with this on site at MARDeC).

- Thus, it is imperative that the training in Indonesia is more focussed on scientific processes: framing research questions, problem solving etc. This has been stressed to the Indonesians.
- Supervisors are also concerned with the development of personal skills such as working in teams, negotiation and leadership along with project management.
- The need for further English language training is especially urgent.

As far as practicable, development of these skills has been addressed in the design of the training modules.

2.3 Recommendations for Cambodian participants

The workshop on Self as a Scientist along with interviews and skills audit have provided useful baseline material from which to monitor and evaluate progress of the Cambodian participants.

It is also provided evidence that the WIL type placements in Indonesia will be effective. This experience will now be enhanced with a well-developed structure to the placement and clear intended learning outcomes and ways of assessing the learning and skills attained.

The experience of working in Papua New Guinea with the National Fisheries Authority using a similar approach showed that specific training in the area of Scientific Research and Processes and in Science Communications were also critical skills gaps. For example, in PNG and more recently in Indonesia, when scientists were asked to “brainstorm” what skills make for “good science” and good scientific practice, experimental research design and communication relevant for different audiences were identified as critical. Based on the above the following is recommended:

- That participants have an opportunity to undertake two further short training workshops in Scientific Research Design and Science Communication
- That additional funds are allocated to enable these additional workshops to be offered before completion of the placements (November 2019).

2. Summary of Recommendations for South-South Project & SRA

1. That the Indonesian trainers are provided with additional skills development in regard to designing and applying learning activities. This would be achieved with 3 staff each from RICAFE Maros and IMRAFE Gondol (total 6 persons) undertaking a one-week visit to Australia (Tasmania) to undertake a 2-day workshop on advanced learning and teaching methods including the use of digital technologies, and to visit aquaculture research and production facilities. Application to be made to ACIAR’s Launch Funds for this activity.

2. That the Cambodian participants have an opportunity to undertake two further short training workshops in Scientific Research Design and Science Communication, to be run in Cambodia before completion of the first round of placements in November 2019. This activity would require additional funding by ACIAR.

3. That the Australian FIS/2016/130 project team use the results of the skills audit to develop and apply targeted training activities (for example, commonly-used experimental designs for larval rearing and nutrition experiments). These can be implemented within the structure and budget of FIS/2016/130, for example during Australian collaborator visits to Cambodia or as add-ons to the annual project meetings.

7.4 Appendix 4: Fish Nutrition: Example of Curriculum Structure

EXAMPLE OF MODULE 1: DEVELOPING SKILLS IN FISH FEED INGREDIENTS & PROXIMATE ANALYSIS

ONLINE BASED TRAINING

Time frame: 5-6 days

No	**Intended learning Outcomes (ILO)**	**Learning Activities**	**Online delivery & technology options**	**Assessment Tasks** **Formative:** Create a Poster Reflections in Journal **Summative:** Report
1.	Be able to *explain* the criteria to select feed ingredients	**Lecture** on feed ingredient and proximate analysis (ILOs 1, 4,5)	Narrated power point Video clips of commom Indonesian ingredient	**Construct a Poster** describing ingredients collected in Cambodia (ILOs 1,2,4)
2	Be able to *apply* basic chemistry	**Practical exercise** on chemical calculation: - To understand basic calculation for making different kinds of chemical solution - (ILOs 2,3,6)	Video clip	
3	Be able to *apply* Lab Safety	- To apply Lab. safety when making chemical solutions		
4	Be able to *conduct* sample preparation and storage	Included in Lecture on Feed Ingredients To identify different ways of preparing samples		
5	Be able to *apply* operational standard procedure of proximate analysis	**Practical Exercise** on how to do proximate analysis - To apply different kinds of SOP for proximate analysis: moisture, ash, protein, lipid, fiber	Create video clips on how to do Proximate Analysis	**Write a Report** on module 1 activities: (description of feed ingredients analysed; data on proximate analysis; factors affecting quality of feed ingredients) (ILOs 3,4,5,6,7)
6	Be able to *trouble shoot*	Included as part of the Discussion of the practical exercise (also as part of overnight reflection)	Included as part of film clip. Develop a set of trouble shooting questions to go with film clip Require students to consider in journal	
7	Be able to collect and manage data and explain data applications	Collect data & store for analysis Worked examples for students to analyse and review on how to collect, manage, analysis and report on data	Create a set of worked examples and develop Quiz/ Q&A which students need to be able to answer to write up their Report.	

Time for zooming	Day 1	Day 2	Day 3
1000-1100 (Day 1 only) 1000-1200	Opening Session	Presentation Poster (Discussing TASK 1) Basic chemistry for nutrition: - To understand basic calculation for making different kinds of chemical solution - Preparing chemical soultion required for proximates analysis (understanding Molar, Normality, etc; dilution) - Chemical reaction	Reflection and checking TASK 2 Samples preparation
PIC	1. Asda 2. Yantek team	Asda MC Undu, Sri Redjeki HM	Sri Redjeki HM Rosni Dian
1400-1600	1. Introduction of Module 1 2. Lecture on feed ingredient and proximate analysis (ILOs 1, 3, 4); Narrated power point and/ or video clip of common Indonesian ingredients) TaSK 1: Construct a Poster describing ingredients collected in Cambodia	To apply Lab. safety when making chemical solutions TASK 2: Making solution with different concentration	To apply different kinds of SOP for proximate analysis (Moisture, ash) - Power point - Video clip
PIC	Asda Rosni	Sri Redjeki HM MC Undu	Sri Redjeki HM Rosni Dian

Time	Day 4	Day 5	Day 6 (optional)
1000-1200	To apply SOP for Lipid and fiber Power point Video clip	Reflection of SOP for proximate analysis Delivering TASK 3 Presentation of Group 1 Presentation of Group 2	Reflection of whole activities for Module 1
PIC	Sri Redjeki HM Rosni Dian	Asda Team	
1400-1600	To apply SOP for Protein Power point Video clip **TASK 3:** Write a Report on module 1 activities - description of feed ingredients analysed; data on proximate analysis; factors affecting quality of feed ingredients Two groups (Group 1 & 2)	Develop a set of trouble shooting questions Video clip. Collect data & store for analysis	
PIC	Sri Redjeki HM Rosni Dian Asda (to explain TASK 3)	Usman Team	

7.5 Appendix 5: Larval Rearing: Example of Curriculum Structure

See attached Powerpoint Presentation.

7.6 Appendix 6: Trainees Self-Assessment Skills Checklist

See attached.

7.7 Appendix 7: Examples of Daily Updates from Participants (WIL and Online)

Daily activity report of the training course on Asian Seabass Larval Rearing ACIAR Project FIS/2016/130 in Institute for Mariculture Research and Fisheries Extension On August 15th, 2019

Prepared by:

1. Mr. **Nget Mat** Chief of Seed Production Division, MARDeC, FiA
2. Mr. **Hok Seiha** Vice chief of Training and Extension Division, MARDeC, FiA
3. Mrs. **Poeurng Sengheang** Officer of Department of Aquaculture Development, FiA
4. Mr. **Hou Virakbot** Officer of Department of Aquaculture Development, FiA

Our today's activities divided into two parts as below:

- **Morning activities**
  - Measured and recorded water parameters such as DO, temperature, saturation, pH and salinity
  - Counted remaining rotifer in each larval rearing tank and provided rotifer 70 ind/larvae (the total number of larvae in each tank is 17,000 individuals and the density of rotifer stoking is 7050 ind/ml)
  - Exchanged 75 liter of treated seawater (treated with 25 ppm of chlorine concentration for 24 hours and dechlorination with sodium hyposulfate concentration in half of chlorine dosage)
  - Provided an small amount of artificial diet the larvae (stated from 7 day old)
  - Provided 1,079 ml of microalgae (*Nannochloropsis* sp.) to larvae in each larval rearing tank, the density of microalgae stoking is 66,75,000 cell/ml
  - Provided probiotics (125 ml of *Alteromonas sp*. BY-9 and 125 ml of *Bacillus*) to the larvae in the three probiotic tanks (P_1, P_2, P_3) excluding control tanks (C_1,C_2, C_3), (normally, the density of probiotic stocking is about 100,000,000,000 cells/ml
  - Counted the number of rotifer in different salinities mass culture tanks (34ppt and 17ppt) and *Nannochloropsis* sp. in (34 ppt and 28ppt). These activities coordinated by Mrs. **Ir. Suko Ismi** and Dr. **Regina Melianawat**
- **Afternoon activities**
  - Provided rotifer 80 ind/larvae (the total number of larvae in each tank is 17,000 individuals)
  - Provided an small amount of artificial diet the larvae
  - Measured and recorded water parameter such as DO, temperature, saturation, pH and salinity
  - Covered larval rearing tanks with clear plastic sheet
  - Counted an initial number of rotifer in different salinities (17 ppt and 34ppt)
- **Interested site**

Seabass larval rearing in IMRAFE, they started to feed artificial diet to from 7 day old

- **Useful techniques**

MARDeC should be modified the feeding scheme for seabass larvae to consume an artificial diet from 7 day old

- *Nannochloroprsis* sp. was brought from IMRAFE to MARDeC since the early 2018 by MARDeCs' staff in last training which supported by JICA. MARDeC used to apply the same fertilizer in microalgae mass culture (*Nannochloroprsis* sp. from IMRAFE) but the result showed that ammonium concentration was high in the water of mass culture tank. To date, MARDeC have cultured and used *Nannochlorum* sp. that derived from Philipine. In this regard, we will discuss with Prof. Hariyanti when she gives us a lecture and practice on live feed laboratory scale culture and ask for starter culture of *Nannochloropsis sp*. for cultivation in MARDeC.

7.8 Appendix 8: Examples of Trainee Reports on Completion of a Module

Accelerating the development of finfish mariculture in Cambodia through south-south research cooperation with Indonesia

Report of Training Module 2 on feed formulation, feed intake, and feeding experiment from 01st to 30th April 2019 in Research Institute of Costal Aquaculture and Fisheries Extension, Maros, South-Sulawesi, Indonesia.

Participants:

Mr. Mak Chankakada

Miss. KHUM SROS

Mr. OEM RAMMANA

Mr. HOEUN PHEARUM

Introduction

Accelerating the development of finfish mariculture in Cambodia through south-south research cooperation with Indonesia which is one project of Australian Centre for International Agricultural Research cooperates with Research Institute of Coastal Aquaculture and Fisheries Extension, and Marine Development and Research Center. This project will provide The training at Indonesia research institute on grow-out nutrition, larval rearing, and PCR analysis. Then, it will have follow-up research and development in Cambodia on nutrition experiment, Larviculture experiments, and survey of viral disease. Thus, the training on feed formulation, feed intake, and feeding experiment was celebrated from 01st to 30th April 2019 in Research Institute of Coastal Aquaculture and Fisheries Extension, Maros, South-Sulawesi, Indonesia. There were four participants from Marine Development and Research Center, Cambodia.

Objective

- Building MARDeC staffs capacity on analyze feed ingredients nutrition (Protein, Lipids, Moisture, Fiber, and Ash)
- Study on feed formulation

- Study on feed making
- Study on feeding experiment.

Activity

We joined the first day in Training on 01st April 2019. The training committees were Dr. Asda Laining, Mr. Chaidir undu, Ms Rosni. We started Cambodia nutrition contain proximately analyze in Aquatic Nutrition Laboratory, Research Institute of Coastal Aquaculture and Fisheries Extension, Maros, South Sulawesi.

We started to analyze ingredient nutrition in aquatic nutrition laboratory, Research Institute of Coastal Aquaculture and Fisheries Research, Maros from 01st to 06th April 2019. Firstly, we toke local Cambodia ingredients (Fish meal, squid meal, rice bran, soybean meal, leucaena leaf meal, moringga leaf meal, coconut meal, brewery yeast). Then, we prepared crucibles, filter papers, soxchlet beaker, digestion flask, boiling chips granules. We added three boiling chip granule in soxchlet beaker, then dry them with crucibles and filter paper in oven at temperature 105 ^{0}C for 2 hours. Then, we put those crucibles in desiccator for 30 minutes and weighted ingredients with empty crucible one by one in balance. We toke those samples to dry in oven at temperature 105 ^{0}C for 2 hours, weighted those dry ingredients and wrote samples' weight in note book for analyzing moisture contain.

Secondly, we weighted 2 g from all samples in balance, then, toke dry crucibles from desiccator, and put those samples in crucibles. Next step, we dry all samples in Muffle furnace in 550 ^{0}C for 2 hours. After that, we toke samples to cool down in desiccator for 30 minute, weighted samples in balance, and wrote all those samples' weight in note book.

Thirdly, we started to analyze protein in those ingredients, which weighted sample 2 g of each ingredient on papers in balance, wrapped and put in digestive flask, added 2 g Selenuim and five boiling cheap granule. Then, we added H2SO4 15 ml with H2O2 3 ml and boiled in fume hood for 10 minutes until samples' color change to light green. After that, we delilute the samples in 100 ml of volumetric flask and turned on distillation unit machine. We used 10 ml of digested solution into distillation flask and added 15 to 20 ml natruim hidroksida-thiosulfat and put the flask in distillation unit. Moreover, we put 25 ml of 4 percent boric acid with Brome Cresol green as the indicator in Erlenmeyer, so distillation sample increased to 150 ml. The last step of protein analyze was Titration which distillated sample in Erlenmeyer with 0.1 N HCl standard to end point (blue to green) and wrote in note book of drop number of HCl in each samples.

Fourthly, we weighted 2 g from each samples in balance then put in soxchlet beaker and added 125 ml petroleum into 250 ml soxchlet beaker for Lipid analyze. We put sample in fat extraction cup with free oil cotton where stayed in soxchlet beaker. Then, all samples were put in Soxtherm hotplate in temperature 105 ^{0}C for 2 hours until all solution evaporate. The lipid concentrations were dry in oven (105 ^{0}C) for 2 hours more. Last step, we toke samples for next fiber analyze, put all samples to release heat in desiccator for 30 minutes, weighted soxchlet beaker on balance, and wrote all lipid samples in note book.

Fifth, we weighted all samples with paper in balance and put in 100 ml beaker for Fiber analyze. Then, we added 50 ml of 1.2 % H2SO4 and boil all the beakers on hot plate 30 minutes. After that, we rinsed those samples with 25 ml hot water for distillation and boil again for 30 minutes. Moreover, we added 50 ml of 3.25% NaOH to heat again for 2 hours, then, samples were filtered with filter paper and 100 ml distill water. After filtering the samples wrapped with filter paper to put crucibles for dry in oven (105 ^{0}C) for 2 hours. Final step, those samples were weighted and noted in note book.

We went to Barru for learning experiment design, practicing on rabbit fish (*Siganus guttatus*) in cage and plastic tank culture. We learn the experiment design and cage culture of rabbit fish (*Siganus guttatus*) on 8th April 2018. We learned how identify the experiment design which should we chose to cage experiment design. Those cages were chosen the completely random design by 5 treatments and using 15 units (1x1x2 m) which were F0 (0 ml of EM), F10 (10ml of EM), F20 (20ml of EM), F30 (30ml of EM), F40 (40ml of EM), stoking density 25 fish / cage (47 g/fish), and feeding was satiation 3 times/day (morning, noon, afternoon) for 90 days.

Other Experiment on rabbitfish (*Siganus guttatus*) culture in RAS system and start culture from 16th to 27th April 2019. Rabbitfish are herbivorous/omnivorous species so this experiment we wanted to know the efficiency between plants oil and fish oil that use in feed. This below were activities: prepare 12 fiber tanks (size: 100L), fish test: Juvenile of Rabbitfish, 4 treatments, 12 replicates, 4 test oil: (Fish oil, coconut oil, palm oil and soybean oil), fish density: 15 fish/tank, feeding: 3 times/day, uneaten feed collection everyday (Siphon), measure body weight and total length of Rabbitfish, RAS system design, experiment by using completely randomized design (Lottery method), use black net to cover on all tanks to protect jump out fish.

Result

Cambodia fishes' feed ingredients data base proximate analyze

We completed to analyze nutrition (Moisture, Lipid, Protein, Ash, and Fiber) from eight local Cambodia ingredients in Aquatic Nutrition Laboratory, Research Institute of Coastal Aquaculture and Fisheries Extension, Maros, South Sulawesi. According to table 1: Cambodia fishes' feed ingredients data base proximate analyze showed that the highest protein ingredient was squid meal (80.30 percent) and lowest protein ingredient was coconut meal (9.08 percent). Moreover, the highest lipid ingredient source was coconut (65.67 percent) and the lowest lipid ingredient source was soybean meal (1.49 percent). The highest ash ingredient source was fish meal (20.36 percent), but the lowest ash ingredient source was coconut meal (2.62 percent). If we look at the rice bran was the highest fiber ingredient source (24.13 percent) and the lowest fiber ingredients source was squid meal (0.03 percent). Lastly, the above data base described about the highest moisture ingredient source was fish meal (10.62 percent) and the lowest moisture ingredient source was coconut meal (3.33 percent).

Table 1: Cambodia fishes' feed ingredients data base proximate analyze

Proximate analyze	Fish meal	Squid meal	Rice bran	leucaena leaf meal	moringga leaf meal	coconut meal	soybean meal	brewery yeast
Moisture	10.62	7.23	8.77	6.01	6.41	3.33	3.91	4.27
Lipid	4.10	4.12	13.80	6.29	8.17	65.67	1.49	11.22
Protein	65.84	80.30	13.50	24.89	24.26	9.08	33.92	28.88
Ash	20.36	5.06	7.81	10.84	9.54	2.62	5.62	5.05
Fiber	6.17	0.03	16.98	8.80	14.05	24.13	1.15	15.06

Sampling the weight and fork length of rabbit fish (*Siganus guttatus*) in cage culture for 1 month

According to table 2 described about sampling the weight and fork length of rabbit fish (*Siganus guttatus*) in cage culture for 1 month which had mean fork length 15.2 ± 0.23 cm with mean body weight 77.7 ± 4.30 g in Treatment F0. Moreover, the mean weight was 70.2 ± 2.40 g and mean fork length was 14.8 cm in treatment F10. Treatment F20 was been sampling mean weight 73.3 ± 2.72 g and mean fork length 15.1 ± 0.18 cm. The mean weight and fork length in treatment F30 were 71.40 ± 1.85 g and mean fork length 15 ± 0.24 cm. Lastly, the below table showed the treatment F40 was been sampling the mean weight and fork length which were 72.6 ± 3.91 g and 15.1 ± 0.25 cm.

Table 2: Sampling the mean weight and fork length of rabbit fish (*Siganus guttatus*) in cage culture for 1 month

	F0		F10		F20		F30		F40	
	Weight (g)	Length (cm)	Weight (g)	Length (cm)	Weight (g)	Length (cm)	Weight (g)	Length (cm)	Weight (g)	Length (cm)
1	76.3	15.3	70.2	14.9	75.5	15.3	72.04	14.98	76.9	15.4
2	74.3	14.9	67.8	14.7	74.1	15.1	72.8	15.2	71.8	15.0
3	82.6	15.4	72.6	14.8	70.2	14.9	69.3	14.8	69.2	14.9
Mean	**77.7**	**15.2**	**70.2**	**14.8**	**73.3**	**15.1**	**71.4**	**15.0**	**72.6**	**15.1**
SD	**4.30**	**0.23**	**2.40**	**0.08**	**2.72**	**0.18**	**1.85**	**0.24**	**3.91**	**0.25**
CV	**5.54**	**1.50**	**3.42**	**0.55**	**3.71**	**1.19**	**2.60**	**1.58**	**5.39**	**1.66**

Stocking the mean weight of juvenile culture rabbitfish*, Siganus guttatus*

According to table 3 described about the stocking the mean weight of juvenile culture rabbitfish, *Siganus guttatus* which showed the mean weight 16.36 ± 0.15 g in T1 and 16.62 ± 0.57 g in T2. Moreover, the mean weight was 16.76 ± 0.54 g in T3 and 16.89 ± 0.68 g in T4.

Table 3: Stocking the mean weight of juvenile culture rabbitfish*, Siganus guttatus*

	T1	**T2**	**T3**	**T4**
	Weight (g)	Weight (g)	Weight (g)	Weight (g)
1	16.53	16.00	17.00	16.13
2	16.27	17.13	17.13	17.07
3	16.27	16.73	16.13	17.47
Avg	16.36	16.62	16.76	16.89
sd	0.15	0.57	0.54	0.68
cv	0.94	3.46	3.24	4.05

Note: T1: Fish oil, T2: Coconut oil, T3: Palm oil, T4 Soybean oil

pH for juvenile rabbitfish (*Siganus guttatus)* culture in tank.

According to fig 1 discribed about mean pH for rabbitfish *(Siganus guttatus*) culture in tank which show T2 increased the highest pH (7.70) on 23rd April 2019. However, The mean pH of T2 decline (pH=7.65) on 24th April 2019. Moreover, it was stable from 25th to 26th April. If we look at T1, T3, and T4 pH increased (pH= 7.62) on 23rd April 2019, but they decline slightly (pH=7.55) on 24th April 2019. Lastly, they increase slightly (pH=6.65) on 25th April 2019, they were stable until 26th April 2019.

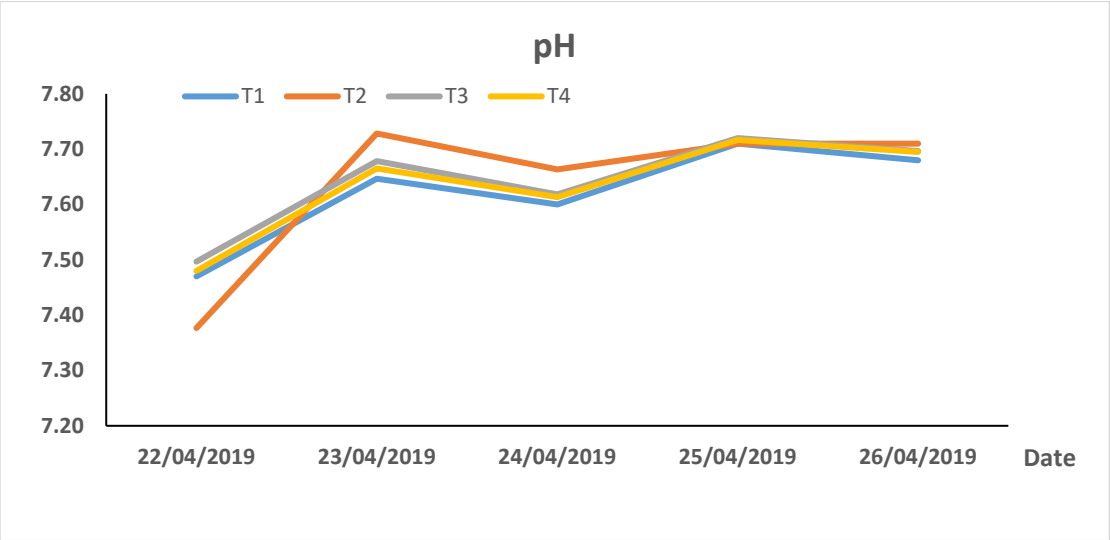

Fig 1 The mean pH for juvenile rabbitfish (*Siganus guttatus*) culture in tank.

Temperature for juvenile culture rabbitfish (Siganus guttatus) culture in tank

According to fig 2 showed about the temperature for juvenile rabbitfish (*Siganus guttatus)* culture in tank which identify mean temperature of T1, T2, T3, and T3 decline dramatically to 28 ^{0}C on 25th April 2019. The temperature decline on that day because had been heavy raining at dawn. However, their mean temperature increase slightly 29 ^{0}C on 26th April 2019.

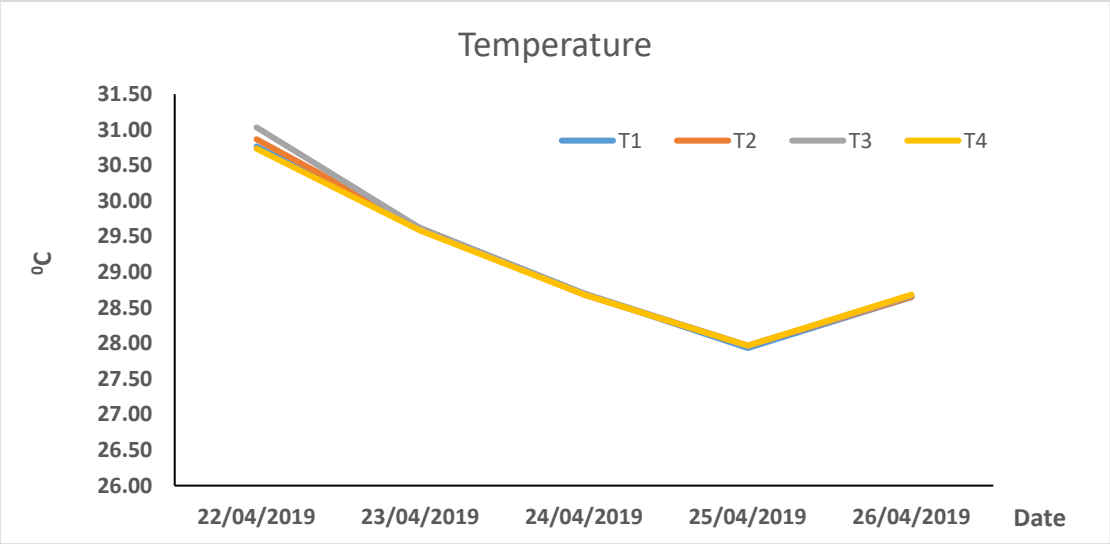

Fig 2 The mean temperature for juvenile rabbitfish (*Siganus guttatus)* culture in tank.

The mean salinity for juvenile rabbitfish (*Siganus guttatus)* culture in tank

The fig 3 showed about the mean salinity for juvenile rabbitfish (*Siganus guttatus)* culture in tank which described salinity increase slightly from 32 to 32.25 ppt (T2) and from 31.95 to 32.30 ppt (T4). Moreover, the salinity of T1 and T3 changed the salinity from 32 to 32.30 ppt. The T1, T3, and T3 salinity still increase (from 32.30 to 32.35 ppt), but the T2 salinity decline slightly from 32.25 to 32 ppt. Lastly, the T1, T3, and T4 salinity decrease a little bit from 32.30 to 32.20 ppt on 26th April 2019.

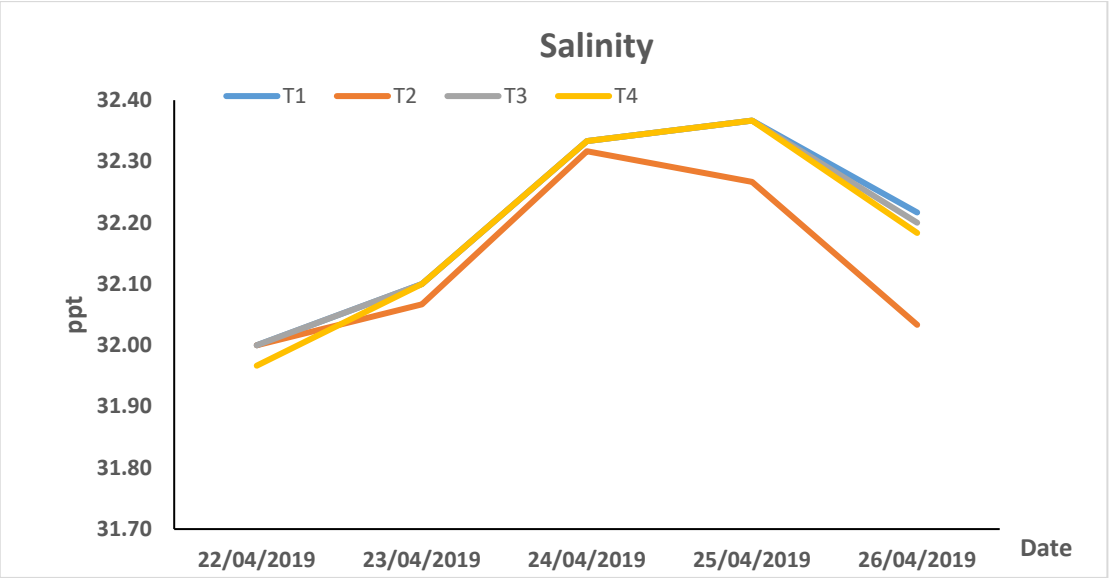

Fig 3 The mean salinity for juvenile rabbitfish (*Siganus guttatus)* culture in tank

The mean feed consumed by juvenile rabbitfish *(Siganus guttatus*) culture in tank

According to table 4 showed the mean consumed by juvenile rabbitfish *(Siganus guttatus*) culture in tank when was started experiment for 10 days (from 16th to 26th April 2019). We started to feed the fish by measured the weight 50 g per each treatment in container. We found the mean feed were consumed in T1 (33.4 ± 3.49 g), T2 (42.77 ± 3.21 g), T3 (39.53 ± 3.99 g), and T4 (39.47 ± 2.35g).

Table 4: The mean feed consumed by juvenile rabbitfish *(Siganus guttatus*) culture in tank

	T1	T2	T3	T4
	Weight (g)	Weight (g)	Weight (g)	Weight (g)
1	31	39.4	38.9	37.1
2	31.8	45.8	35.9	39.5
3	37.4	43.1	43.8	41.8
Average	33.4	42.77	39.53	39.47
SD	3.49	3.21	3.99	2.35
CV	10.44	7.51	10.09	5.95

Note: T1=Fish oil, T2=Coconut oil, T3=Palm oil, T4=Soybean oil

Conclusion

The eight ingredients were collected from three different place in Preah Sihanouk province, Cambodia which was analyzed on the nutrition of each ingredient in aquatic nutrition laboratory. We found that protein of Fish meal (65.84 percent), squid meal (80.30 percent), rice bran (13.50 percent), leucaena leaf meal (24.89 percent), moringga leaf meal (24.26 percent), coconut meal (9.08 percent), brewery yeast (28.88 percent). The soybean meal protein is proximately analyzing which was found .

If we look at mount of fiber in coconut meal was 24.13 percent and lipid in coconut meal was high in amount 65.67 percent. Moreover, the lowest ash mount was coconut meal (2.62 percent) and the coconut meal had low amount of moisture (3.33 percent).

The rabbit fish culture in cage for 1 months which was sampled and analyzed the mean fork length 15.2 ± 0.23 cm with mean body weight 77.7 ± 4.30 g in Treatment F0. Moreover, the mean weight was 70.2 ± 2.40 g and mean fork length was 14.8 cm in treatment F10. Treatment F20 was been sampling mean weight 73.3 ± 2.72 g and mean fork length 15.1 ± 0.18 cm. The mean weight and fork length in treatment F30 were 71.40 ± 1.85 g and mean fork length 15 ± 0.24 cm. Lastly, the below table showed the treatment F40 was been sampling the mean weight and fork length which were 72.6 ± 3.91 g and 15.1 ± 0.25 cm.

The stocking the mean weight of juvenile culture rabbitfish, Siganus guttatus which showed the mean weight 16.36 ± 0.15 g in T1 and 16.62 ± 0.57 g in T2. Moreover, the mean weight was 16.76 ± 0.54 g in T3 and 16.89 ± 0.68 g in T4.

The mean pH for rabbitfish (Siganus guttatus) culture in tank which show T2 increased the highest pH (7.70) on 23rd April 2019. However, The mean pH of T2 decline (pH=7.65) on 24th April 2019. Moreover, it was stable from 25th to 26th April. If we look at T1, T3, and T4 pH increased (pH= 7.62) on 23rd April 2019, but they decline slightly (pH=7.55) on 24th April 2019. Lastly, they increase slightly (pH=6.65) on 25th April 2019, they were stable until 26th April 2019.

The temperature for juvenile rabbitfish (*Siganus guttatus*) culture in tank which identify mean temperature of T1, T2, T3, and T3 decline dramatically to 28 0C on 25th April 2019. The temperature decline on that day because had been heavy raining at dawn. However, their mean temperature increase slightly 29 0C on 26th April 2019.

The mean consumed by juvenile rabbitfish *(*Siganus guttatus) culture in tank when was started experiment for 10 days (from 16th to 26th April 2019). We started to feed the fish by measured the weight 50 g per each treatment in container. We found the mean feed were consumed in T1 (33.4 ± 3.49 g), T2 (42.77 ± 3.21 g), T3 (39.53 ± 3.99 g), and T4 (39.47 ± 2.35g).

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In conclusion, we could choose commercial fish meal use for main protein source because we saw it's protein level was high and price of this ingredient was cheap, so we can use it as main protein source in feed formulation in Cambodia. Moreover, the coconut meal has high lipid well and the it's price was cheap, so we could use it as main lipid source in feed formulation. We found that coconut had low moisture contain, it was good ingredient from plant which is low moisture in feed formulation.

The growing fork length and weight for rabbit culture in cage for 1 month which showed grow constant. Then, the stocking mean weight of juvenile culture rabbitfish, Siganus guttatus which were the same weight in experiments.

The water quality (pH, temperature, and salinity) and feed consumed in treatment which were not difference for 10 days.

Suggestion

After we joined The Training on feed formulation, feed intake, and feeding experiment in Research Institute of Coastal Aquaculture and Fisheries Research where we could learn skill to analyze nutrition in feed ingredients, feed formulation, feed intake, and feeding experiment

We suggest have new training about scientific writing and data analyze training which will have more lecture and practice.

Report of E-Training Module 1 on

Fish Nutrition Research – Module 1-Fish Feed Ingredient and Proximate Analysis

from 24 to 28 August 2020

Cohort 2

Prepared by:

Sen Sorphea
Yong Chomnou
Pel Samnang

Introduction

E-training was conducted by lab nutrition and feed technology of Research Institute of Coastal Aquaculture and Fisheries Extension, (RICAFE) Maros with cooperation of Australian Centre for International Agricultural Research. This project provides the training on fish nutrition and proximate analysis. The training will be provided as 4 Modules on Fish feed ingredient and proximate analysis, Feed formulation feed making and feeding experiment, Data analysis and interpretation and Understanding of scientific process as a topic for module 1 to 4 respectively. The module 1 about the Fish feed ingredient and proximate analysis has been achieved as a e-training which is occurred on 24 to 28 August 2020.

Objective

- Capacity building on feed nutrition and ingredient analyzing (Protein, Lipids, Moisture, Fiber, and Ash)
- To identify the feed ingredient selection
- To understand basic chemistry and lab safety
- To introduce sample preparation

Activity

Before start the training section. welcome speech: RICAFE Maros, prof. Janelle, Dr. Mike and Dr. Bambang Suprakto, Director of Center for Fishery Research and Introduction of the module from Dr. Asda to participants.

The first lecture is about the Introduction training on Fish Nutrition which is provided detail activity and the step of module 1 through the ILOs (Intended Learning Outcome). The next

lecture introduces the Feed ingredients for aquafeed in Indonesia. From this lecture, participant understand on:

- Benefit use of artificial in aquaculture
- Type of common fish feed used
- Dietary nutrient such as macro nutrient (protein, lipid and carbohydrate) and micro nutrient (vitamin, mineral and additive)
- How to select the feed ingredients for formulate diet.
- Some data of approximate analysis of ingredients use as fish feed in Indonesia such as: shrimp head meal (SHM), Golden snail meal (*Pomacea* sp) (GSM) and how to process of GSM, Vermil meal- seaworm-earthworm, plant origin sources such as copra cake meal, soybean meal (SBM), rice bran, corn meal, seaweed meal.

After lecture, 3 topics of assignment were proposed as the poster presentation for each group:

- Group 1: Potential feed ingredient available in Cambodia
- Group 2: Select potential feed ingredients for hybrid catfish
- Group 3: Alternative fish feed in Cambodia

The main objective of the assignment encourages the participants to think about the potential of local feed ingredient which can be potential used as fish feed in Cambodia and give reason why selected those ingredients. After poster presentation, participants got a lot of good commend from lecturer about how to prepare a poster and which information should add in poster.

Second lecture on the Basic chemistry which provided with practice exercise and video clip on how to prepare the solution. Participants learned:

- How to convert from percentage to ppt (part per thousand) and ppm (part per million)
- How to write the Chemical formula
- How to do chemical calculation of Mole
- Molarity which is the number of moles in dilute in the solution

The third lecture is about the Sample preparation and storage by Dr. Usman. From both the lecture in PowerPoint and video clip, participants learn on:

- How to sampling to minimize error when taking sample
- Homogeneity of sampling
- Number of samples to represent the whole material
- How to store or keep sample properly
- Method of drying such as: dry in an oven, under the sun and freezer dryer

The fourth lecture is how to apply lab Safety when making chemical solution. From lecture participant understand on:

- How to do self-protection from chemical solution
- How read the symbol on label of chemical
- How to use first aid
- How to minimize accidental during and working in laboratory
- Rule when enter laboratory such as wear: lab coat, glove, glasses, mask, shoes, etc. Participant sharing the experience during working in the lab at the last section of the lecture.

The last lecture on Standard Operation Procedure (SOP): Proximate analysis such as moisture, ash, protein, lipid, fiber is provided by Dr. Asda with clear explanation in lecture and video clip. The detail of each session as follow:

1. Moisture analysis

- Equipment and material use in analysis are:
  - Crucible to store the sample,
  - Analytical balance to weight the sample,
  - Digital oven to dry the sample,
  - Desiccator to cool down the sample and
  - Forceps to transfer the sample.

- Procedure:
  - Conditioning the oven until reaching a stable condition at 105^{o}C (approximate 15 min)
  - Put the empty crucible and dry in the oven at the set temperature at least 2 hrs
  - Cool down in a desiccator within 30 min and weigh (weight A g)
  - Accurately weight the samples approximate 2 grams and put into the crucible (weight B g)
  - Place crucible containing sample in oven and drying at 105 ^{0}C for 16 – 24hrs.
  - Use forceps to move the crucible into desiccator for 30 min and weigh the crucible
  - Repeat the heat until constant weight (difference weight app 0.0005 g) (weight C g)

  Formula:

  Percent moisture = B – C / B – A * 100

  Where: A = Weight (g) of empty crucible
  B = Weight (g) crucible + sample before heating
  C = Weight (g) crucible + sample after heating

2. Ash analysis

- Equipment and material are:
  - Muffle furnace to ash the sample,
  - Crucible to store the sample,
  - Analytical balance to weight the sample,
  - Desiccator to cool down the sample and
  - Forceps to transfer the sample.

- Procedure:
  - Place empty crucible in a muffle furnace
  - Conditioning the muffle by turning the knop to 550 ^{0}C and heating the crucible at this temperature for 2 hrs
  - Decrease the temperature into ± 40 ^{0}C before removing the empty crucible from muffle and put into a desiccator. Leave the crucible in desiccator for 30 minutes and weight (weight A g)
  - Weigh accurately 2 g of homogenized sample into ash crucible and then place in muffle furnace carefully (weight B g)
  - Increase the temperature step wise to 550 ^{0}C, maintain temperature for 3 - 4 hrs until sample becomes a white ash
  - Decrease the temperature to 38 – 40 ^{o}C. Use forceps to move the crucible out of muffle.
  - Put into the desiccator for 30 min and weigh crucible (weight C g)

- If white ash is not occurred, repeat the heating. Moisten ash firstly with distilled water, slowly dry on a hotplate, and re-aching at 550 ^{0}C to constant weight. Before taking out the sample, decrease the temperature to ± 40 ^{0}C and put the crucible in to a desiccator for 30 minutes and weight. Repeat until constant weight 0.0005 g.

Formula:
Percent Ash = B – C / B – A * 100

Where: A = Weight (g) of empty crucible
B = Weight (g) crucible + sample before heating
C = Weight (g) crucible + sample after heating

3. Protein analysis

- Equipment and material are:
  - Distillation Unite,
  - Digestion apparatus,
  - Fume hood,
  - Filter paper to store the sample,
  - Analytical balance to weight the sample,
  - Desiccator to cool down the sample,
  - Digital oven to dry the sample,
  - Standing Biuret,
  - Digestion flask,
  - Erlenmeyer,
  - Volumetric flask,
  - Hot plate,
  - Sulphoric Acid (H_2SO_4),
  - Hydrogen peroxide (H_2O_2)
  - Distil water,
  - Selenium Reagent,
  - Boric Acid (4%),
  - Chloredrix Acid (HCl),
  - Indicator,
  - Selenium and Boiling chip
  - Pipette

- Procedure**:**
  - Weight filter paper (weight A g),
  - Put 2 grams of the sample was added, then folded and put into a 100 ml digestion flask,
  - Added 2 grams of the mixture of selenium and a few grains of boiling stones then added 15 ml of H_2SO_4 and 3 ml of H_2O_2 slowly then let it steep for 10 minutes in an acid chamber. Then the digestion device was heated for 2 hrs, until the solution became clear greenish, then allowed to cool until it reached room temperature.
  - After that it is diluted and put in a 100 ml volumetric flask, align it to the mark of the line. 10 ml pipette solution and put into a distillation device then 10 ml sodium hydroxide-thiosulfate are added.
  - Furthermore, distillation is carried out and is accommodated in an Erlenmeyer containing 25 ml of a 4% boric acid (H_3BO_3) solution containing an indicator as a distillate container, until the volume reaches a minimum of 150 ml. After that it was titrated with standardized 0.2 N HCl, the color changed from brick red to less pink

color. Then the end of the distillation hose is rinsed with distilled water. The same is done with working on blanks.

Formula:

% Nitrogen = (ml HCl – Blanko) x No. HCl x 14.007 x 10 ml from sample) / sample weight, g

% Protein = % Nitrogen x 6.25 (Correction factor for feed)

4. Lipid analysis

- Equipment and material are:
  - Extraction thimble,
  - Filter paper to store the sample,
  - Analytical balance to weight the sample,
  - Desiccator to cool down the sample,
  - Digital oven to dry the sample,
  - Boiling stone,
  - Extraction beaker glass,

- Procedure:
  - Prepare Soxhlet beaker and put into dry oven for 2h at 105 ^{o}C and weight (weight B g)
  - Weight empty filter paper and record in lab book
  - Accurately weight 2 g of sample in filter paper (weight A g)
  - Wrap filter with sample and keep in Soxhlet beaker then dry in oven for 2h at 105 ^{o}C
  - After 2 hrs in oven put 3 of boiling stone into Soxhlet beaker
  - Put filter tube in Soxhlet beaker and then put free oil cotton into filter tube
  - Then put sample under free oil cotton
  - Add 125 ml petroleum benzene into Soxhlet beaker
  - Put in the Soxtherm hotplate and turn on the machine
  - Extract the sample for approximate 2h 18 min until evaporated
  - After extract move Soxhlet beaker from machine and move filter tub
  - Then move sample and keep for fiber analysis
  - Put the Soxhlet beaker into dry oven for 2h at 105 ^{o}C
  - Take out from oven and put into desiccator for 30 min
  - If not constant put in oven 3 - 4 times until constant and weight (weight C g)

Formula:

% Lipid = C – B / A

Where: A = Sample weight
B = Weight of empty Soxhlet beaker
C = Weight of lipid constraining Soxhlet beaker

5. Fiber analysis:

- The equipment's required for fiber analysis:
  - Analytical balance to weight the sample,
  - Hotplate to boil sample,
  - Filter paper to store the sample,
  - Crucible to keep the sample,
  - Funnel to filter the sample,

- Desiccator to cool down the sample,
- Forceps to transfer crucible,
- Digital oven to dry the sample,
- Erlenmeyer (volume 250 ml) to counter the sample.

➢ Procedure
- Weight accurately 2 g of fat-free sample in the 100 ml beaker
- Add 50 ml of 1.2% H_2SO_4
- Boil using a hot plat for 30 min
- Add 50 ml of 3.25% NaOH then heat again for 30 min
- Dry empty crucible and blank filter paper at 105 ^oC using oven 2h (weight A g)
- After boiling filter sample with filter paper that has been weight together with the cup
- Wash the sediment which exist on filter paper with distill water which added has been 3 ml of sulfuric acid in 1liter
- After sediment if free of acids and bases dry and add 20 ml of concentrate alcohol, then wrap and enter in a crucible than enter in a crucible that has been weight,
- Dry crucible in 105 ^oC in oven for 2 hrs.,
- Remove the crucible to the desiccator 30 min and weight crucible until constant weight (weight B g)

Formula
% Fiber = B - A / gram sample weight

Where: A = weight (g) of empty crucible
B = weight (g) crucible contain fiber sample

Conclusion

This training had some challenging since participants could not practice in lab by online; moreover, participants learn by the video which clearly explain about technique. Participants learn about the selection of feed ingredient, basic chemical, lab safety, sample preparation and proximate analysis (such as Moisture, Ash, Protein, Lipid and Fiber). Each lecture provided discussion, homework, presentation and writing report. Participants take turn to practice on summarize activity and writing daily report.

Acknowledgements

First of all, we would like to show my deepest gratitude to project of Australian Centre for International Agricultural Research cooperates with lab nutrition and feed technology of Research Institute of Coastal Aquaculture and Fisheries Extension, (RICAFE) Maros, Indonesia.

I would like to thanks to Mr. Thay Somuny, director of DAD (Department of Aquaculture Development) and Mr. Mam Sokdara, director of MARDeC (Marine Aquaculture Research and Development Center) for selecting us as candidates to attend the training.

Let's not forget our thanks to all lectures, for taking tightly schedule and giving us the best opportunity to gain knowledge on fish nutrition.

7.9 Appendix 9: Examples of Trainee Presentation

See attached Powerpoint Presentation.

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Appendices 1-3 Evaluation Data & Baseline Reports

Appendix #	Content
Appendix 1 Tables 1 & 2 summarising data & evaluation criteria	FIS-2018-115 Curriculum Evaluation FIS2018_115 Evaluation Professiona
Appendix 2 Summary of notes from collaborative inception meeting to determine training needs	MARDeC 17th November Inception M
Appendix 3 Evaluation & Baseline Report (November 2019	Appendix 1 Initial Evaluation and Baselir

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Appendices 4 & 5 Examples of Fish Nutrition & Larval Rearing Curriculum Design

Appendix #	Content
Appendix 4: Fish Nutrition Example of Curriculum Structure (ILOs, Tasks & Learning Activities)	Appendix 5 Example of Online Nutrition Tr
Appendix 5: Larval Rearing: Example of Curriculum Structure (ILOs, Tasks & Learning Activities)	Appendix 2 Example of Training Modules-F

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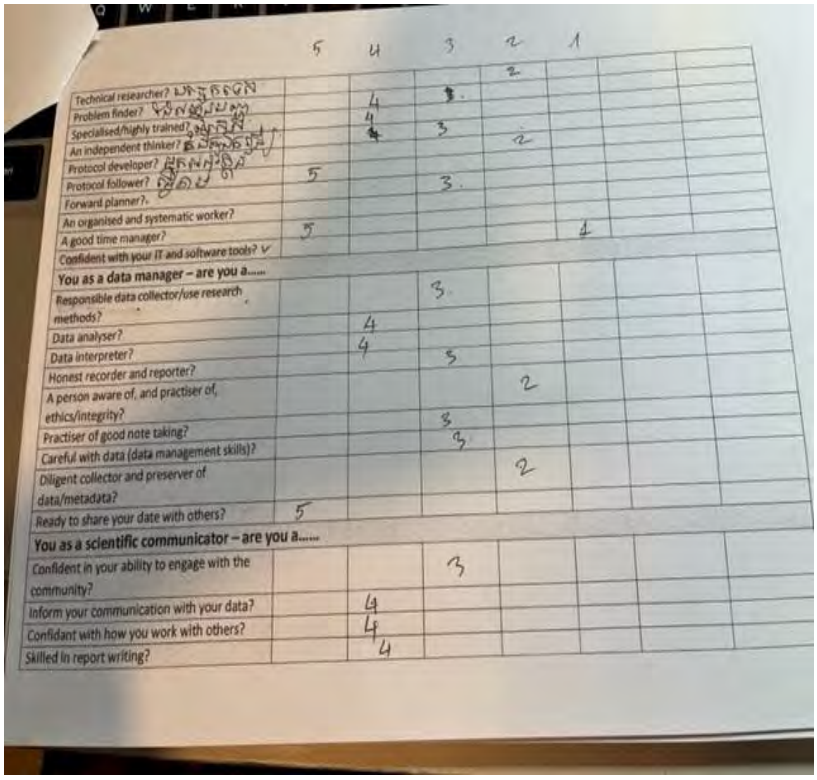
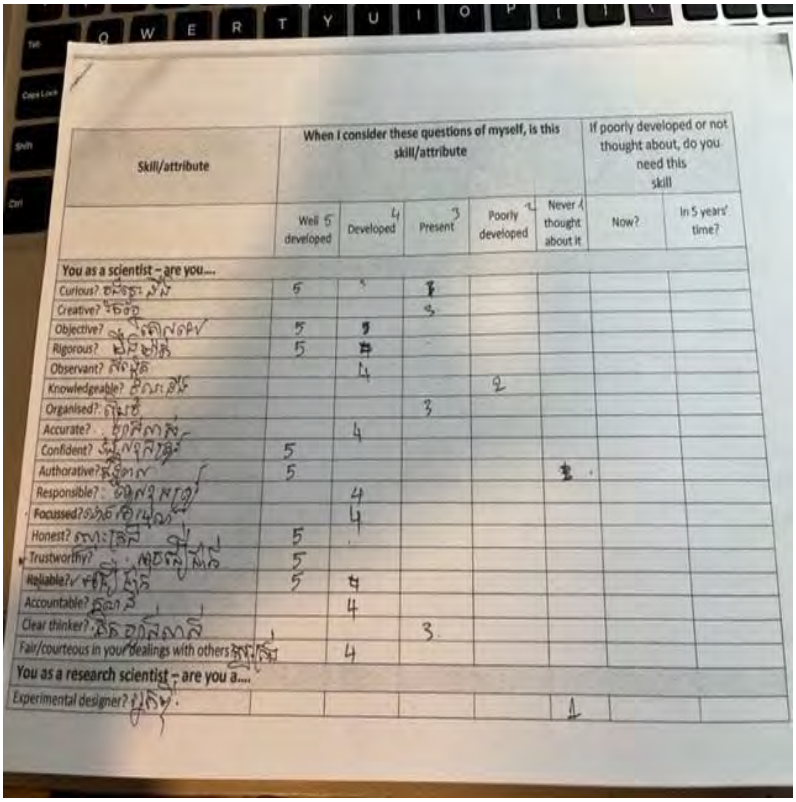
Appendix 6 Trainees Self Assessment Skills Checklist



	5	4	3	2	1		
Technical researcher?				2			
Problem finder?		4	3				
Specialised/highly trained?		4					
An independent thinker?			3	2			
Protocol developer?							
Protocol follower?	5		3				
Forward planner?.							
An organised and systematic worker?							
A good time manager?	5				1		
Confident with your IT and software tools?							
You as a data manager – are you a.....							
Responsible data collector/use research methods?			3				
Data analyser?		4					
Data interpreter?		4	3				
Honest recorder and reporter?				2			
A person aware of, and practiser of, ethics/integrity?			3				
Practiser of good note taking?			3				
Careful with data (data management skills)?				2			
Diligent collector and preserver of data/metadata?							
Ready to share your date with others?	5						
You as a scientific communicator – are you a.....							
Confident in your ability to engage with the community?			3				
Inform your communication with your data?		4					
Confidant with how you work with others?		4					
Skilled in report writing?		4					



Skill/attribute	When I consider these questions of myself, is this skill/attribute					If poorly developed or not thought about, do you need this skill	
	Well developed 5	Developed 4	Present 3	Poorly developed 2	Never thought about it 1	Now?	In 5 years' time?
You as a scientist – are you....							
Curious?	5		3				
Creative?			3				
Objective?	5	3					
Rigorous?	5	4					
Observant?		4					
Knowledgeable?				2			
Organised?			3				
Accurate?		4					
Confident?	5						
Authorative?	5				1		
Responsible?		4					
Focussed?		4					
Honest?	5						
Trustworthy?	5						
Reliable?	5	4					
Accountable?		4					
Clear thinker?			3				
Fair/courteous in your dealings with others?		4					
You as a research scientist – are you a....							
Experimental designer?					1		

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Appendices 7 & 8 Trainees' WIL Updates and Module Completion Reports

Appendix #	Content
Appendix 7: Examples of Daily Updates from Participant (WIL and Online)	 Example Daily_activity_report_o
Appendix 8 Examples of Trainee Reports on Completion of A Module	 Example of Participant Report of  Final Report of Training Module 1.do

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Appendix 9: Example of Trainee Presentation

Appendix #	Content
Appendix 9 Example of Trainee Presentation	Trainee Presentation for Final Project Meeti