TRAINING ON

QUALITY ASSURANCE FOR GREENFEED™ USERS IN THE REGION

4-6 February 2025 | SEARCA & UPLB DTRI, Philippines

COMPLETION REPORT

Training on Quality Assurance for GreenFeed™ Users in the Region

Hegarty, R. S., Bremner, G. J., Almeida, A. K., Bacorro, T. J., Pascua, S. N. S., Ramos, N. A., & SEARCA (Southeast Asian Regional Center for Graduate Study and Research in Agriculture). 2025. *"Training on Quality Assurance for GreenFeed™ Users in the ASEAN Region: Completion Report."* Completion report of the training activity held on 4 to 6 February 2025 at SEARCA and University of the Philippines Los Baños - Dairy Training and Research Institute (UPLB-DTRI), Los Baños, Laguna, Philippines.

This project was funded through the New Zealand Government's Climate Smart Agriculture Initiative as part of its contribution to the Global Research Alliance on Agricultural Greenhouse Gases (GRA) and the University of California Davis, through funding from the Global Methane Hub.

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ACRONYMS

C-Lock – C-Lock Inc.
CH_4 – Methane
CO_2 – Carbon Dioxide
DTRI – Dairy Training and Research Institute
GF – GreenFeed™
GHG – Greenhouse Gas
H_2 – Hydrogen
N_2 – Nitrogen
QA – Quality Assurance
SIM – Subscriber Identity Module
SEARCA – Southeast Asian Regional Center for Graduate Study and Research in Agriculture
UPLB – University of the Philippines Los Baños
UC Davis – University of California, Davis
NZAGRC – New Zealand Agricultural Greenhouse Gas Research Centre

LIST OF APPENDICES

EXECUTIVE SUMMARY

The “Training on Quality Assurance for GreenFeed™ Users in the Region” brought together 17 participants from Bangladesh, Cambodia, Ethiopia, Indonesia, the Philippines, Thailand, Vietnam, and the US, fostering regional collaboration on livestock greenhouse gas (GHG) management. Held from 4 to 6 February 2025, the training was hosted at the University of the Philippines Los Baños-Dairy Training and Research Institute (UPLB-DTRI) by the Southeast Asian Regional Center for Graduate Study and Research in Agriculture (SEARCA). This initiative, jointly led by the Philippine and Vietnam Greenhouse Gas Measurement Hubs, was supported by the New Zealand Government's Climate Smart Agriculture Initiative and the University of California, Davis.

The training primarily aimed to provide participants with the knowledge and practical skills necessary to operate, maintain and troubleshoot GreenFeed™ units – an advanced, cost-effective, and non-intrusive tool used to measure livestock-related GHG emissions, particularly methane. GreenFeed™ technology plays a crucial role in helping researchers and farmers collect accurate emissions data, which is essential for designing mitigation strategies to reduce the environmental impact of livestock production.

The training opened at SEARCA with participants welcomed by Prof. Roger Hegarty, GHG Measurement Trainer from the New Zealand Agricultural Greenhouse Gas Research Centre (NZAGRC); Dr. Shimels Wassie, Research Program Manager for the Global Methane Hub Project at the University of California, Davis; Dr. Amado Angeles, Dean of the College of Agriculture and Food Science at UPLB; and Dr. Nur Azura Binti Adam, SEARCA's Deputy Director for Programs. Dr. Nova Ramos, Head of SEARCA's Education and Collective Learning Department - Training for Development Unit (ECLD-T4DU), introduced the participants and the technical working group. Prof. Hegarty set the stage with an engaging lecture on the role of GreenFeed™ in livestock GHG measurement, describing it as “remarkably effective.”

Participants engaged in practical hands-on sessions, where they unpacked, assembled, and commissioned the GreenFeed™ unit under the guidance of Mr. Graeme Bremner, Consultant, NZAGRC. The session covered equipment setup, package verification, safety protocols, and troubleshooting techniques. Participants also learned to navigate the GreenFeed™ User Interface and the Control Feed App, enabling them to monitor live data and execute commands remotely.

The second day of the training centered on troubleshooting and calibration, with participants practicing modem and SIM card installation, gas recovery, and equipment maintenance. They also toured UPLB-DTRI's Dairy Technology, Breeding and Physiology, and Nutrition laboratories, gaining insights into various tools used in animal science research.

The last day of the training emphasized experimental design, data integrity, and best practices in GHG measurement. Participants learned to interpret collected data and develop actionable strategies for measuring methane emissions from livestock operations. Individual hands-on exercises on GreenFeed™ unit maintenance and an introduction to the headbox respiration chamber, as well as best practices for managing animals during experiments, were covered.

The training equipped participants with the skills and knowledge to effectively commission, operate, and maintain GreenFeed™ units in real-world applications and ensure accurate and reliable GHG measurements.

This initiative is part of Global Research Alliance's ongoing efforts to bolster international collaboration in GHG measurement, contributing to efforts to reduce methane emissions and reinforcing the role of livestock research in climate action and sustainable agricultural practices.

INTRODUCTION

Rationale

Climate change has become an increasingly urgent global challenge, with livestock production in the agriculture sector contributing significantly to greenhouse gas emissions (GHGs), particularly methane. Methane is a potent greenhouse gas, and reducing its emissions is crucial for meeting climate goals, improving environmental sustainability, and ensuring long-term agricultural resilience. Effective mitigation of livestock-related GHG emissions requires precise measurement and monitoring, which in turn allows for the development of tailored strategies to reduce emissions and enhance overall sustainability in the sector.

In Southeast Asia, the growing demand for livestock products coupled with the region's diverse agricultural practices calls for stronger, more effective systems for GHG measurement. The **Training on Quality Assurance for GreenFeed™ Users in the Region** was specifically designed to address this gap by enhancing the region's ability to measure and monitor methane emissions from livestock.

The training aimed to equip participants with the skills needed to operate and maintain GreenFeed™ units — one of the broadly applicable effective tools for measuring methane emissions. By doing so, it sought to empower participants to improve local GHG measurement practices and contribute to regional climate goals. Through hands-on learning and expert guidance, the training provided practical solutions to strengthen the region's capacity for monitoring livestock emissions, ultimately supporting the global fight against climate change.

Learning Objectives and Expected Outcomes

The learning objectives of this training were designed to provide a comprehensive understanding of GreenFeed™ technology. By the end of the workshop, participants were expected to:

1. Have a high level of understanding of the GreenFeed™ technology
    - Learn what GreenFeed™ is and how it measures methane emissions from livestock
    - Gain skills needed to perform basic maintenance, calibration, and repairs on GreenFeed™ units
    - Learn to retrieve, analyze, and troubleshoot data collected by GreenFeed™

2. Setup and operate GreenFeed™ units
    - Get hands-on experience in assembling, setting up, and operating GreenFeed™ units, including internet and power options

3. Design methane emission studies
    - Understand how to plan and design experiments using GreenFeed™, including how many animals and visits are needed
    - Learn how to introduce and train animals to use the GreenFeed™ system for accurate data collection

Through these learning objectives, the training aimed to build participants' expertise in GHG measurement techniques and enable them to contribute to the development of region-specific strategies for reducing livestock-related methane emissions. Ultimately, this workshop sought to advance regional collaboration and empower participants to play a pivotal role in the global effort to combat climate change.

Participants and Participating Countries

Seventeen participants from eight countries, including Bangladesh, Cambodia, Ethiopia, Indonesia, the Philippines, Thailand, Vietnam, and the United States attended the workshop.

WORKSHOP HIGHLIGHTS

Opening Program

The training workshop began with a warm welcome from several distinguished representatives of the learning event organizers. Their introductions set the tone for a comprehensive and engaging workshop, emphasizing shared commitment to collaboration, key objectives of the training, and clear expectations for all participants.

Prof. Roger Hegarty, representing the New Zealand Agricultural Greenhouse Gas Research Centre (NZAGRC), welcomed everyone and expressed gratitude for the collective contributions of all participants and partners to this important initiative. He highlighted New Zealand's ongoing support under the country's Climate Smart Agriculture Initiative for the development of greenhouse gas measurement systems in the Philippines and Vietnam.

Prof. Hegarty also noted the significant contributions of greenhouse gas research teams in addressing global challenges and, as such, their commitment to helping universities in other countries build their own capacity for greenhouse gas research.

Dr. Shimels Wassie, Research Program Manager for the Global Methane Hub Project at the University of California, Davis (UC Davis), stressed the importance of international collaboration in finding solutions to reduce methane emissions. He emphasized that this training marks a key milestone in the greenhouse gas measurement hub development projects, a unique initiative that includes critical elements such as ration formulation in livestock diets.

Dr. Wassie acknowledged the challenges involved, and emphasized its significance and the potential impact it will have on participants' future work in greenhouse gas measurement and mitigation.

Dr. Amado Angeles, Dean of the College of Agriculture and Food Science (CAFS) of the University of the Philippines Los Baños (UPLB), extended a warm welcome to the participants on behalf of the UPLB Chancellor, Dr. Jose V. Camacho, Jr. He reaffirmed UPLB's dedication to advancing agricultural research and promoting climate resilience through innovative scientific practices.

Dr. Angeles also highlighted the ongoing partnership between UPLB, New Zealand, and UC Davis, and welcomed the collaborative efforts on the greenhouse gas research project. With the UPLB facility set to play a pivotal role in the workshop's success, he expressed enthusiasm for the continued partnership and collaboration among all stakeholders.

Dr. Nur Azura Binti Adam, Deputy Director for Programs of the Southeast Asian Regional Center for Graduate Study and Research in Agriculture (SEARCA) expressed SEARCA's dedication to regional capacity-building and its ongoing efforts to promote sustainable agriculture and climate action across Asia. She encouraged all participants to fully immerse themselves in the packed training program and take advantage of the opportunity to collaborate with fellow attendees.

Dr. Nur also highlighted the importance of not only learning but also enjoying the vibrant locale of Los Baños, known as the Special Science and Nature City of the Philippines, during this enriching experience.

Dr. Nova Ramos, Head of the Training for Development Unit of SEARCA's Education and Collective Learning Department (ECLD-T4DU), introduced the participants, the technical working group, and the heads of the different SEARCA units and departments present to welcome the participants to the Center and to Los Baños. Her introduction fostered a collaborative atmosphere, ensuring that everyone felt engaged, connected, and supported in their learning journey.

Training Sessions and Activities

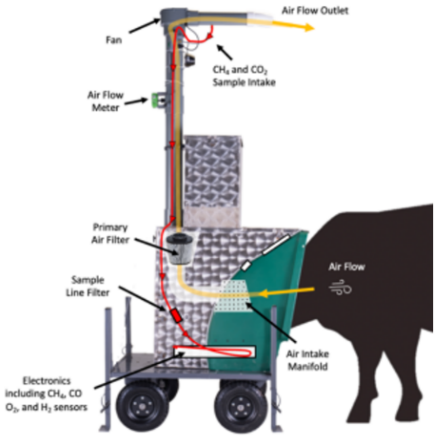
The training program was structured around a comprehensive series of sessions designed to provide participants with hands-on experience using GreenFeed™ technology and to enhance their technical expertise in livestock GHG measurement.

Module Overview

Module 1: Introduction to GreenFeed™ Technology and Methane Measurement
Module 2: Unpacking, Assembling, and Understanding GreenFeed™ Unit
Module 3: System Setup, Testing, and Troubleshooting Techniques
Module 4: Data Access, Integrity, and Analysis
Module 5: Experimental Design for GHG Measurement
Module 6: Managing Animals and GreenFeed™ During Experiments

Day 1: Introduction to GreenFeed™ Technology and Hands-on Assembly

The first day of the training focused on the introduction to GreenFeed™ technology and its role in measuring methane emissions. Prof. Hegarty delivered an engaging presentation on the technology, underscoring its effectiveness in capturing accurate methane measurements from livestock.



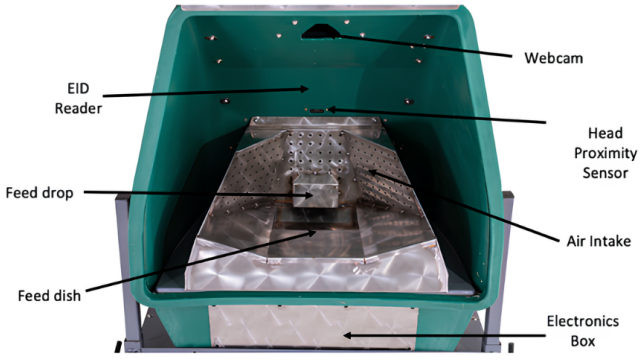


Photo credit: C-Lock Inc.

He acknowledged that for many participants, this might be their first experience measuring methane, making this project a significant milestone for them. He also addressed potential comparisons with other systems, providing context for where GreenFeed™ fits within the broader landscape of methane measurement technologies, and explaining its unique advantages.

As Prof. Hegarty explained, “The more you’ve been engaged in putting something together, the better you’ll be able to keep it running.” Participants then had the opportunity to engage in hands-on activities, including assembling and commissioning the GreenFeed™ unit of UPLB-DTRI.

Mr. Graeme Bremner explained that GreenFeed™ usually comes in three separate boxes, which are not always shipped together. Each box contains an important component of the unit, and if any boxes are missing, the assembly process cannot proceed. The largest of the three boxes arrives first, housing the main unit, while the other boxes typically take longer to arrive, usually within 2–3 weeks after.

Mr. Bremner inspected the largest box, which contains the GreenFeed™ unit. He explained the process of checking and taking photos of the impact indicators, whether they turn red, before opening the box to document any potential damage.

Before assembling the GreenFeed™ unit, each part and accessory from the boxes was individually named. It was clarified that the tools provided in the boxes should be sufficient to assemble the unit.

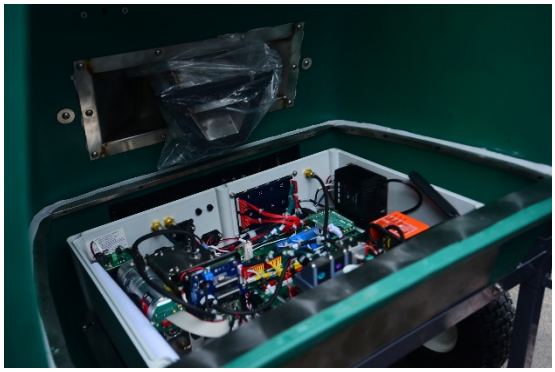
Participants assembled the GreenFeed™ unit from the box to a fully set-up system.

This practical experience was a crucial element of the training, ensuring that participants not only learned the theory behind the technology but also gained the confidence to operate it effectively.

Additionally, participants learned how to navigate the app's user interface, manage live data using smart phone, and execute remote commands using the Control Feed app from C-Lock Inc. These foundational skills provided participants with a strong understanding of the system's capabilities and their applications.

Day 2: Communications, System Maintenance, Calibration, and Laboratory Tour

The second day focused on configuration and troubleshooting communications, and performing manual calibration. Participants learned how to establish an internet connection between the GreenFeed™ unit and C-Lock, locate the modem, and insert activated SIM cards into the GreenFeed™ port under the feed dish.



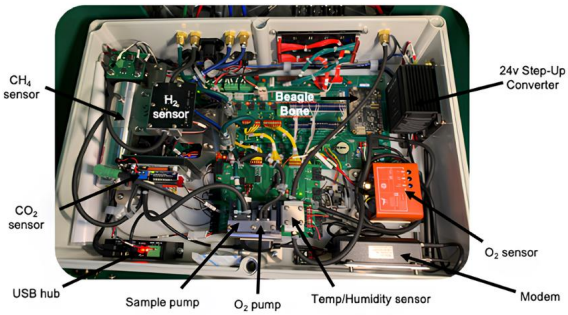


Photo credit: C-Lock Inc.

For this session, the details of the application were explained further, and participants were introduced to commands that can be activated directly from the app when standing near the unit during experiments. GreenFeed™ gathers data every second and automatically uploads it for C-Lock to process, provided there is an internet connection. The data uploads periodically but can also be triggered manually using the app. The unit was powered on, and participants were divided into groups to practice using the app under Mr. Bremner's guidance.

For unit 448 above, an Auto-calibration Recovery System is used, incorporating a single high-pressure gas cylinder with gas concentrations of 3.5 percent CH_4, 11.5 percent CO_2, 400ppm H_2 with the balance being N_2. The gas release is programmed by C-Lock to occur every seven (7) days, but only when no animals are present. However, C-Lock suggests doing a manual calibration to verify the results of the auto-calibration system of the unit.

Hence, a monthly manual CO_2 recovery test was demonstrated and then practiced as part of the workshop.

As GreenFeed™ is mobile and can be moved, preparation for relocation and partial disassembly was done before transporting the GreenFeed™ unit to the farm for practice the next day. Proper disassembly every time must be carried out to keep the system working for a long time.

In addition to these technical sessions, participants had the opportunity to tour UPLB-DTRI's specialized laboratories, including areas such as dairy technology, animal breeding and physiology, and animal nutrition. This tour enhanced their understanding of the tools and methods employed in livestock research at UPLB-DTRI.

Day 3: Experimental Design and Best Practices for GHG Measurement

On the third and final day, the training focused on data access and interpretation, experimental design, and best practices for GHG measurement.

The day started with participants logging in the GreenFeed™ website to familiarize themselves with the interface, learn where to find the data they wanted to collect, and understand which settings could be adjusted.

Participants were taught how to summarize the data provided by the machine and which specific data points to prioritize. Since C-Lock regularly monitors the data on the website, knowing how to locate and download the information efficiently is crucial for speeding up the research process.

To reinforce this practical session, participants were given worksheets to test their understanding of the data available on the website. They also explored the effects of changing machine settings, preparing them to conduct their experiments effectively with GreenFeed™.

Before heading to the farm, Prof. Hegarty delivered a lecture on experimental design and management. Participants developed a deeper understanding of how to interpret collected data and apply it to experimental setups. They learned how to incorporate GreenFeed™ findings into actionable strategies for methane emission reduction, ultimately improving their ability to design effective experiments for livestock GHG measurement.

In the afternoon's session, the group proceeded to the farm site, where they practiced maintenance procedures on the GreenFeed™ units, including changing and cleaning primary air filters, cleaning the feed dish, and checking for feed blockages, which are part of the standard maintenance every seven (7) days.


SUKRUTHAI
SOMHAI

In relation to GHG measurement systems, participants were also given a tour and engaged in a discussion about the headbox respiration facility at the farm, which is also used to measure greenhouse gas emissions in livestock.

Training animals before experiments is essential for the success of the measurements. As such, participants were taught how to properly train animals to naturally approach and eat from the GreenFeed™ unit, including gently enticing the animals with food rewards.

The day ended with the participants returning to the DTRI Auditorium for the closing ceremony of the training where they watched a video of the past three (3) days and were awarded certificates of completion.

Prof. Hegarty and Mr. Bremner were likewise given certificates and tokens by SEARCA for serving as key trainers during the learning event.

KEY LEARNINGS AND SKILLS ACQUIRED

Throughout the training, participants gained a set of technical knowledge and hands-on skills aligned with the learning objectives:

- **Comprehensive Understanding of GreenFeed™ Technology:** Participants gained a deep understanding of how GreenFeed™ works to measure methane emissions from livestock. They learned the technology's key components, its role in livestock management, and how it helps capture accurate data on GHG emissions.
- **GreenFeed™ Setup and Operation:** Participants received hands-on experience in assembling, setting up, and operating a GreenFeed™ unit. This included configuring internet connections, power options, and using the system to capture real-time data, ensuring they could confidently operate the system in their own.
- **System Troubleshooting, Maintenance, and Calibration:** Participants developed practical skills in maintaining, calibrating, and troubleshooting a GreenFeed™ unit. They learned how to perform manual carbon dioxide recovery, conduct regular maintenance, fix technical issues, and ensure consistent data collection for reliable methane measurements.
- **Data Interpretation and Experimental Design:** The training also focused on data retrieval, analysis, and interpretation. Participants were taught how to design methane emission studies, including planning, animal training, adjusting experimental setups, and using collected data to develop actionable emission reduction strategies.

These skills equipped participants with the tools necessary to implement, maintain, and optimize GreenFeed™ systems for effective methane measurement and sustainable livestock management which they can apply in their respective countries.

CONCLUSION

The training successfully met its objectives by equipping participants with the essential skills to operate and maintain their GreenFeed™ units. The knowledge and skills learned during the training will significantly impact efforts to reduce methane emissions from livestock operations and contribute to global climate action goals. It also marked a significant milestone in fostering regional collaboration among Southeast Asian nations and international stakeholders. By bringing together 17 participants from eight countries, the training helped strengthen regional ties, facilitating the exchange of best practices and insights in livestock GHG measurement. Furthermore, it laid the groundwork for future collaborations, creating opportunities for continued knowledge sharing and collective action.

Looking ahead, continued collaboration, capacity building, and the exchange of knowledge will be critical to sustaining progress in sustainable livestock management and climate resilience in the region. As participants return to their countries with enhanced technical capabilities, they are well-positioned to contribute to the long-term reduction of livestock-related GHG emissions and to the broader global effort to mitigate climate change.

FUTURE ACTIONS

As participants return to their respective countries, they are encouraged to apply the skills and knowledge learned during the training to enhance and implement more effective GHG measurement systems within their local contexts. Continued collaboration between participants, partner organizations, and stakeholders will be crucial for ensuring long-term success in reducing methane emissions from livestock operations.

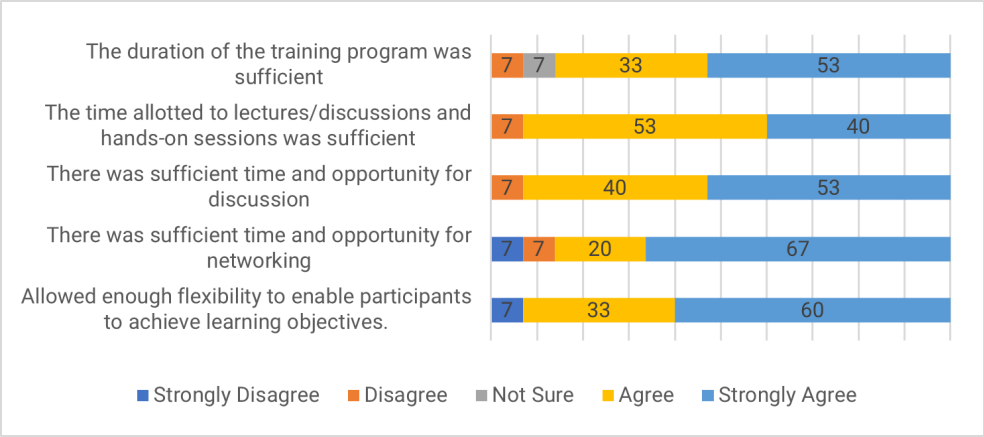
SUMMATIVE EVALUATION

Participants were requested to provide feedback to the **Training on Quality Assurance for GreenFeed™ Users in the Region** for a summative evaluation of the training program. Below is a summary of the responses from the 15 participants who completed the evaluation form.

Program Evaluation

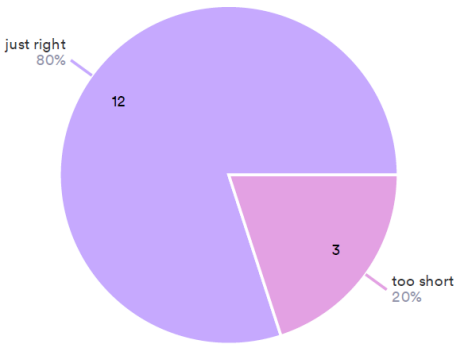
A. Time allotment

Majority of the respondents ***strongly agreed*** on the four statements on time allotment section. Sixty-seven percent of the respondents strongly agreed that there was sufficient time and opportunity for networking, while less than half (40%) strongly agreed that the statement on time allotted to lectures/discussions and hands-on sessions was sufficient. The respondents suggested having more time and emphasis on familiarizing participants with the user interface, system application, research experimental design, animal adaptation techniques, and additional time for animal testing up to data collection.



Responses to time allotment section (in percentages)

When asked about their opinion on the duration of the training program, 80 percent of the respondents found it to be **just right**, while 20 percent felt it was too short.



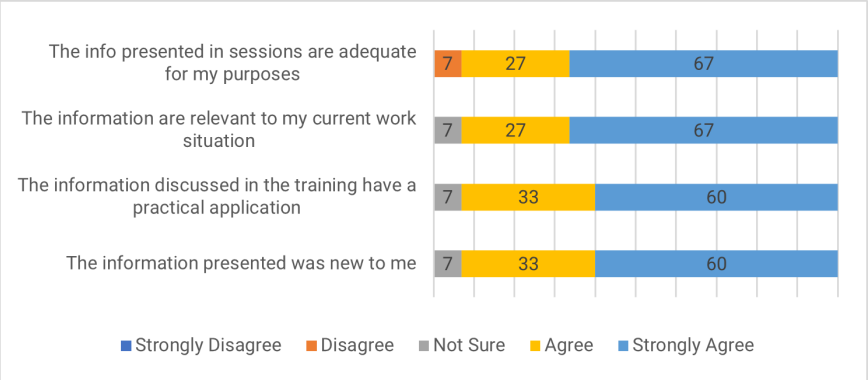
Responses to the duration of the training program

When asked which sessions they would like to have less time or emphasis, respondents noted that the assembly part had taken up a significant amount of time.

A few respondents also requested a bit more time for discussions, and some expressed the need for more break time, as the training schedule was quite tight.

B. Contents/Topics

Similar to the time allotment section, the four statements regarding the content of the training received **strong agreement** from the respondents, with percentages of 60 percent and 67 percent (9-10 respondents).



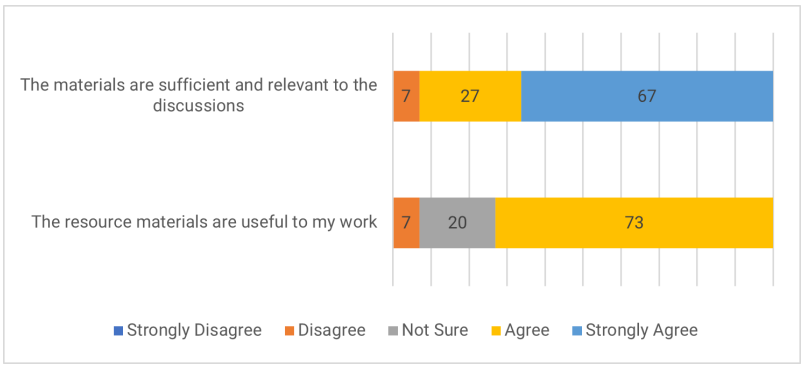
Responses to the contents/topics section (in percentages)

Meanwhile, the effectiveness of the lecture sessions was rated highly, with 73 percent of respondents rating it a 5 (the best response), 20 percent rating it a 4, and 7 percent rating it a 3. Hands-on sessions also received high ratings, with 60 percent of participants giving it a 5, followed by 33 percent rating it a 4, and 7 percent rating it a 3. The responses on the quality of the training program showed similar results, with 73 percent of responses rating it a 5, 20 percent rating it a 4, and 7 percent rating it a 3.

Many participants also found the training to be sufficient but suggested lengthening some parts of the discussions.

C. Course Materials and Exercises

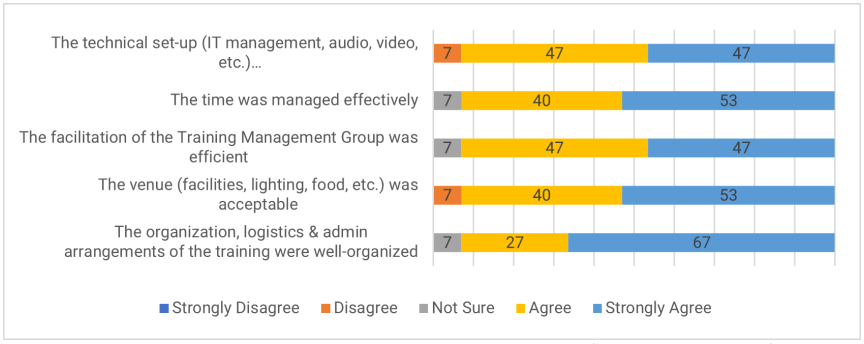
Seventy-three percent of respondents found the course materials to be useful for their work, and 67 percent found them to be sufficient and highly relevant to the discussions.



Responses to the course materials and exercises section (in percentages)

D. Administrative Arrangements

The participants found the administrative arrangements **strongly agreeable** and expressed gratitude for the well-organized arrangements.

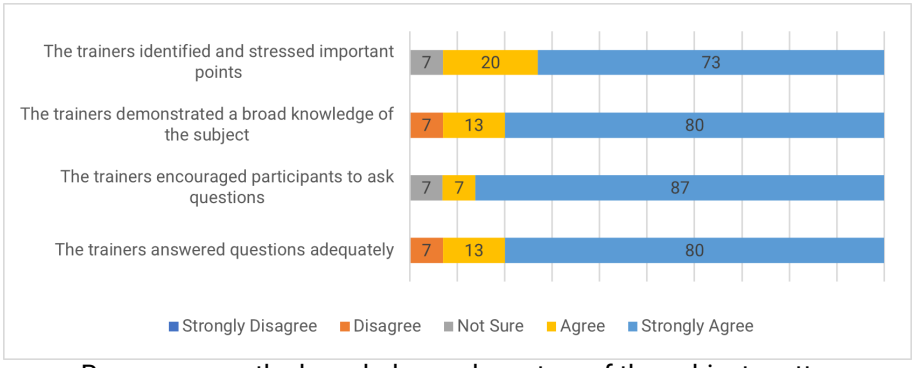


Responses to administrative arrangement (in percentages)

Trainer Evaluation

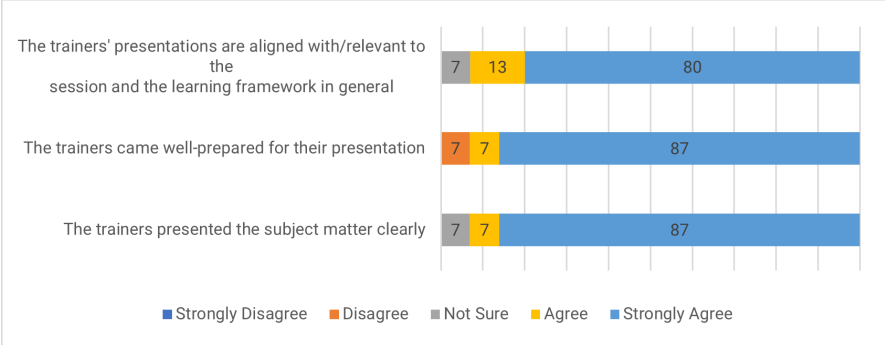
The trainers were also evaluated by the participants. Overall, the trainers received high ratings in all areas (i.e., knowledge and mastery of the subject matter, organization and planning, motivation and learning, and resource person-participant interaction), with participants finding them helpful and excellent in their roles.

A. Knowledge and Mastery of the Subject Matter



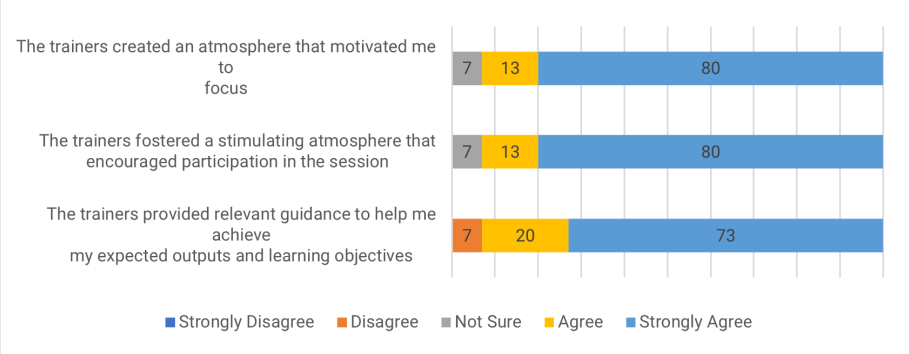
Responses on the knowledge and mastery of the subject matter of the trainers (in percentages)

B. Organization and Planning



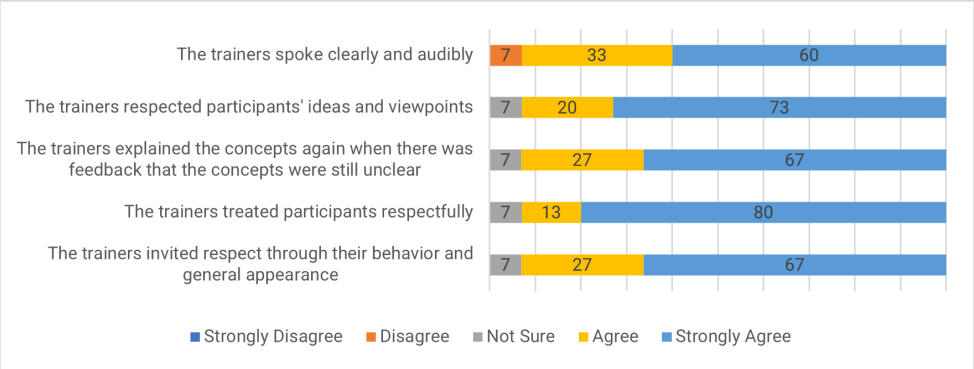
Responses on the organization and planning of the trainers (in percentages)

C. Motivation and Learning



Responses on motivation and learning (in percentages)

D. Resource Person-Participant Interaction



Responses to resource person-participant interaction (in percentages)

Learning and Takeaways

Participants were asked about their key takeaways and insights from the training program. The answers varied but can be summarized as, "GreenFeed™ is a sophisticated technology used to measure methane emissions, which is highly beneficial to greenhouse gas research."

Many participants gained a better understanding of how to use and install the GreenFeed™ unit. They also learned the crucial lesson that training animals is vital for the success of GreenFeed™ measurement studies. It was emphasized that animals must be allowed to consume feed naturally when using the GreenFeed™ system.

When asked to describe the training program, participants described it as "superb, important, informative, and helpful," noting that it improved everyone's understanding and made them ready to use their GreenFeed™ units.

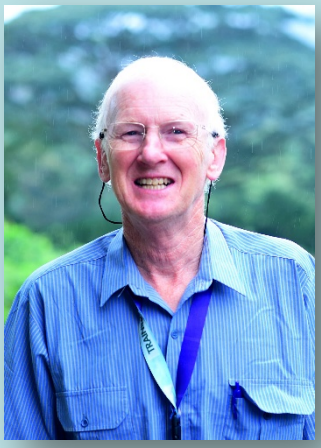
Regarding follow-up training, some participants suggested focusing on hands-on training and practical troubleshooting for common issues. They also expressed interest in learning about new technologies and fostering a better network among GreenFeed™ users in the region.

Ninety-three percent of participants would recommend the training to their colleagues, staff members, co-researchers, livestock workers, and students.

Overall, 80 percent of participants rated the training highly (5 as the highest and 1 as the lowest), 13 percent rated it a 4, and 7 percent rated it a 3. Participants commented on the importance of the training within their organization, highlighting that the program was informative, comprehensive, and provided appropriate activities.

APPENDIX A

Instructors and Content Developers

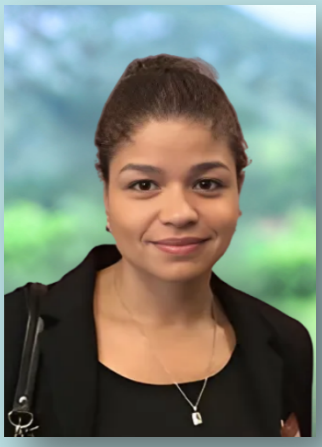


Prof. Roger Hegarty

A leading researcher in animal science and methane emissions, Prof. Hegarty's expertise spans ruminant nutrition, feed conversion efficiency, and methane production mitigation. His interdisciplinary work integrates themes like grazing, residual feed intake, methanogenesis, and fatty acid metabolism. With over 300 citations on his methane-related studies, his recent work includes a universal equation to predict methane production in forage-fed cattle and innovative methodologies to estimate daily methane emissions using short-term breath measures.

Mr. Graeme Bremner

Mr. Graeme Bremner is a highly experienced Technical Officer with over four decades of dedicated involvement in animal research. He has been the principal technician responsible for the operation and quality assurance (QA) of the University of New England's (UNE) respiration chambers and GreenFeed™ units. His meticulous approach to QA processes has facilitated groundbreaking research and the development of innovative methodologies in livestock management and environmental sustainability. Graeme's deep technical knowledge, practical skills, and unwavering commitment to excellence make him an invaluable contributor to the field of animal science and research.



Dr. Amelia Almeida

Amelia is a Senior Lecturer in Animal Science at Massey University, New Zealand's premier dairy research and teaching facility. She has international experience in Brazil, the USA, Australia, and New Zealand working in small and large ruminant feeding standards development and emission measurement. She has provided extensive input into these notes and advice on GreenFeed™ use in dairy systems.

APPENDIX B

SEARCA Training Management Group

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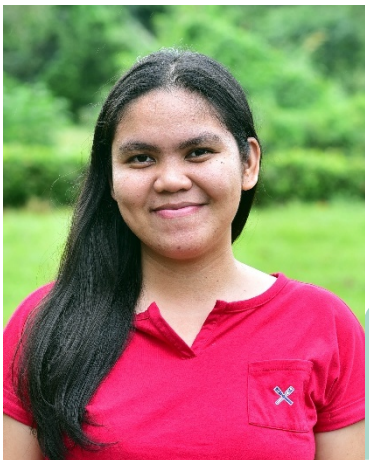

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APPENDIX C

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APPENDIX D

Program of Activities

APPENDIX E

PowerPoint Presentation

APPENDIX F

Workshop Module

APPENDIX G

Information Packet