FRAME

Needs Assessment Report

for the

Forest Restoration Research Unit (FORRU), Department of Biology, Faculty of Science Chiang Mai University

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1. Justification for the assessments

For many decades, the natural resources sectors and commercialization of agriculture have driven rapid economic growth in Greater Mekong sub-region (GMS). However, commercial agriculture, with promises of high returns from monocrops, is costly. The environmental costs experienced by, for example, smallholders establishing rubber and banana plantations in exchange of traditional forest crops yielded only minimal and delayed financial returns. This, accompanied by inefficient resource use, has led to increased competition for resources, rising costs and a growing set of ecological constraints, which will pose challenges to the economic viability of forest-restoration efforts, agricultural livelihoods and food security in the coming decades.

Thailand's forests have been declining, formerly due to commercial logging and more recently due to conversion to agriculture, infrastructure development and fires, largely as a consequence of population growth, resulting in a decrease in forest cover from 53.5% in 1961 to 31.6% in 2014. Thailand's current government ordered authorities to put an end to deforestation nationwide. The government also promised to increase the country has forested land from 31.5 percent to 40 percent by 2024. Yet Thailand's history of state-managed forestry has not solved the underlying causes of deforestation nor created the incentives needed for forest restoration. Ramping up state-managed forestry does not seem to be the solution to Thailand's deforestation problem. One solution might be to put trust in the country's forest-dependent villagers, who not only know the forests best, but also depend on them for their livelihoods, and thus have an incentive to sustain them. Thailand could overcome one of the main reasons for mismanagement of forests, by improving the skillsets of all stakeholders involved in managing them. This could be achieved by improving the higher education (HE) in forestry, and making it accessible to forest managers.

Several universities in Thailand offer Bachelor's and Master's degree courses, related to forest and natural resources, but with different emphases. Kasetsart University, offers courses on forestry, agriculture and fisheries; Chiang Mai University is known for courses on farming systems and natural resource management and Khon Kaen University for courses on rural development and regional planning. Mae Jo University offers courses on land use and ecotourism, whilst Chulalongkorn University concentrates on community forestry. Forestry knowledge, over the past 83 years, has accumulated in various forms of teaching materials, e.g., technical manuals, papers and internal reports with limited distribution mainly in academic circles. Therefore, country's forestry education should be updated and expanded to keep pace with modern forestry education.

Thailand's education system stands at a crossroads. With the country's growing integration into the world economy, it has invested significantly in education sector. However, Thailand has not received the expected return, although, it is encouraging to see access to education widened through the country and it has performed relatively well in international assessments compared with its peers. Therefore, Thailand needs to focus on four priority areas to prepare students from all backgrounds for a fast-changing world. The first priority is to revise and improve curriculum. The second priority is to build capacity to reliably assess students across the full range of competencies needed for success in life and in learning. Third, Thailand needs to develop a holistic strategy to prepare teachers and all the stakeholders to deliver education reform, including implementing the revised curriculum, and to tackle teaching shortages in the most deprived areas. The final challenge is to create a comprehensive information and communications technology strategy to equip all Thailand's HEIs, teachers and students. Presently, Thailand is pursuing increased integration into the global education community, with an emphasis on ASEAN partners. The number of collaborative programs between Thai and foreign HEIs is on the rise, and governments have emphasized internationalization of the Thai education system in recent years. Hence, this proposal considers these recommendations alongside the capacities of the Programme HEIs to ensure realistic and feasible objectives.

Considered the above mentioned, the objectives of this project support the strategic development plan of partner HEIs thus fitting into the national and institutional context.

2. Methodology for the assessment

A national needs-assessment workshop was run online, on the 9th April, 2021. It was hosted by Chiang Mai University's Forest Restoration Research Unit (FORRU) and the Faculty of Science's Doi Suthep Nature Center, with the participation of stakeholders from four sectors (Figure 1):

1. Government bodies – Regional Environment Office 1 (Chiang Mai), Queen Sirikit Botanic Garden, and Chiang Mai Provincial Offices for Natural Resources and Environment (Ministry of Natural Resources and Environment), The 16th Conservation Area Administrative Office and Doi Suthep-Pui National Park (Department of National Parks, Wildlife and Plants), and Forest Resource Management Office No. 1 (Chiang Mai) (Royal Forest Department)
2. Non-governmental organizations – Thai Rak Pa Foundation, Seub Nakhasathien Foundation, RECOFTC
3. Private sector companies and small forest managers – Bangchak Corporation Public Company Limited,
4. Other HEIs – Faculty of Science (Chiang Mai University), Faculty of Forestry (Kasetsart University), Faculty of Science (Chulalongkorn University), Faculty of Environmental Management (Prince of Songkla University) and Savannakhet University and Souphanouvong University (Lao PDR)

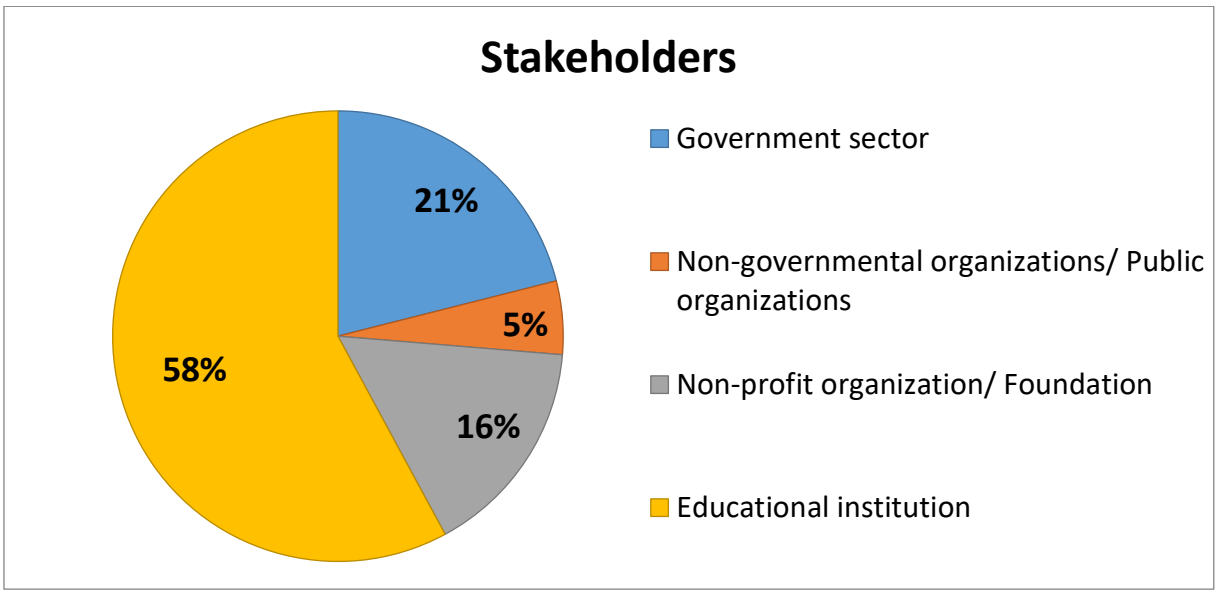

Figure 1 Stakeholders participating in the Thailand's needs-assessment workshop

Prior to the national need assessment workshop, questionnaires were distributed, requesting stakeholders' inputs on traditional and MOOC courses, related to forest restoration, to be established and upgraded at Chiang Mai University. Thus, inputs (Figures 2-7) were gathered from stakeholders who otherwise would have not been able to participate. There are suggestions on the courses as in Table 1.

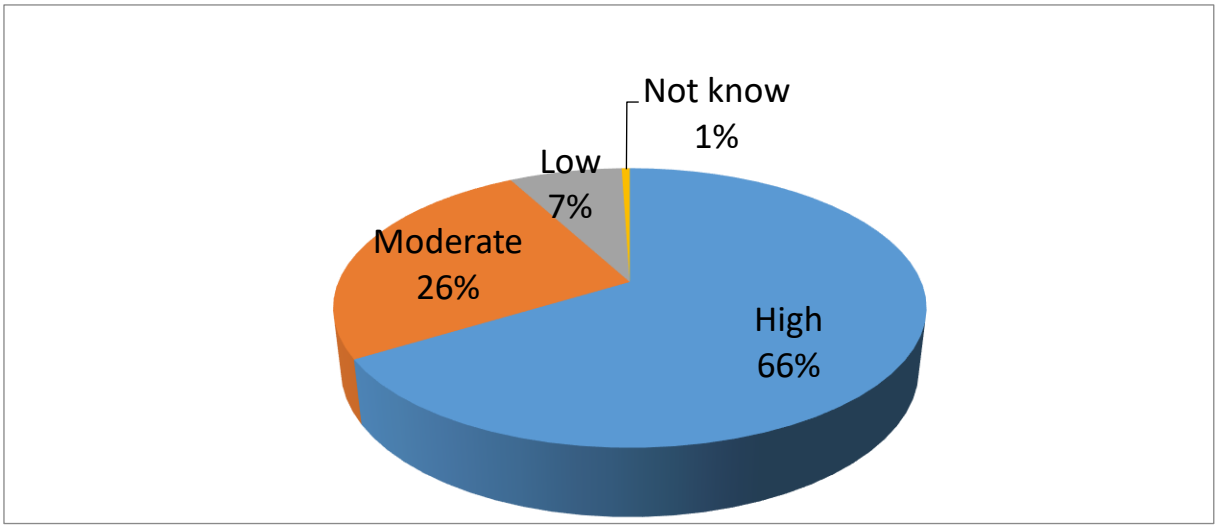

Figure 2 Level of overall agreement on the BSc course on forest restoration

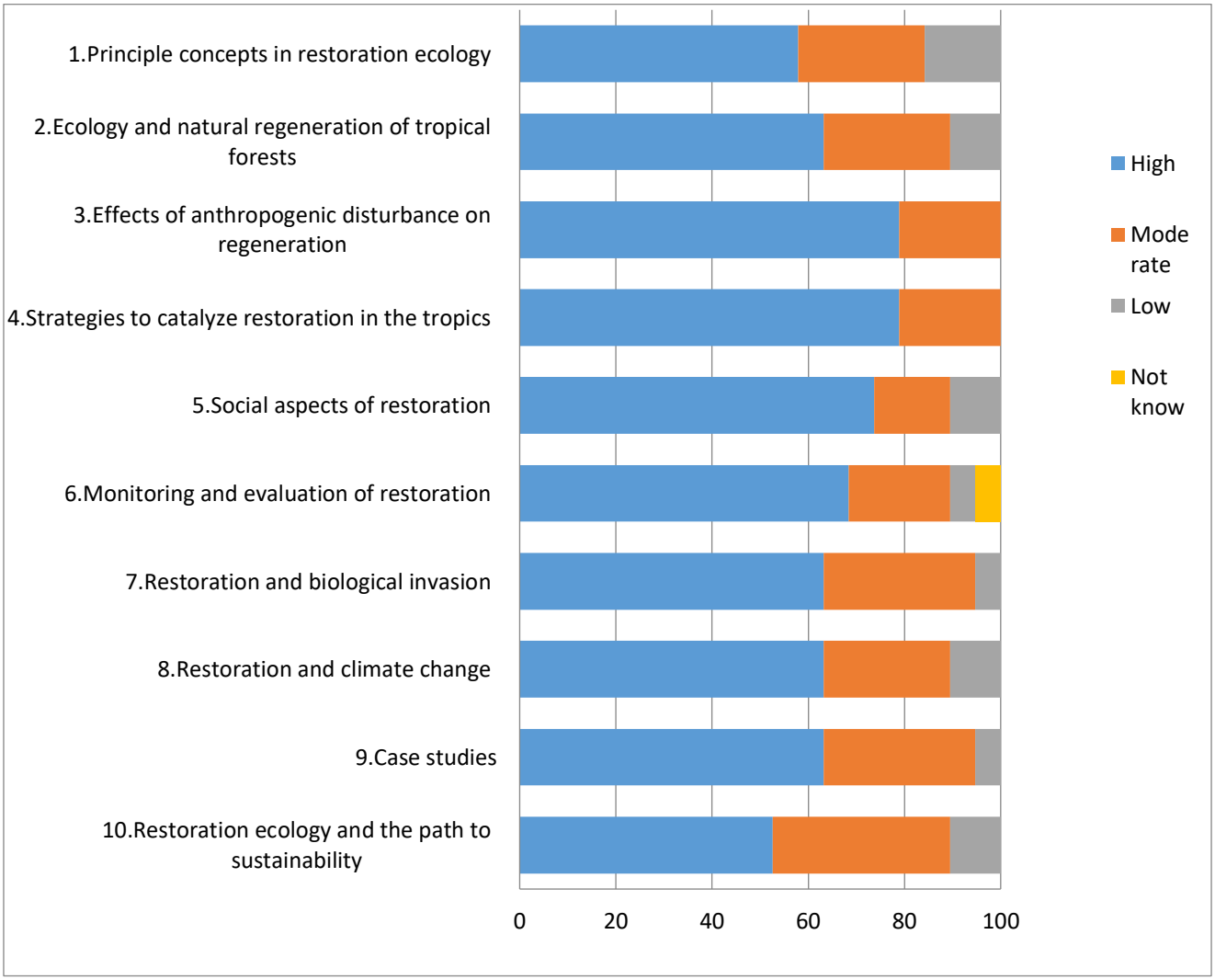

Figure 3 Level of topical agreement on the BSc course on forest restoration

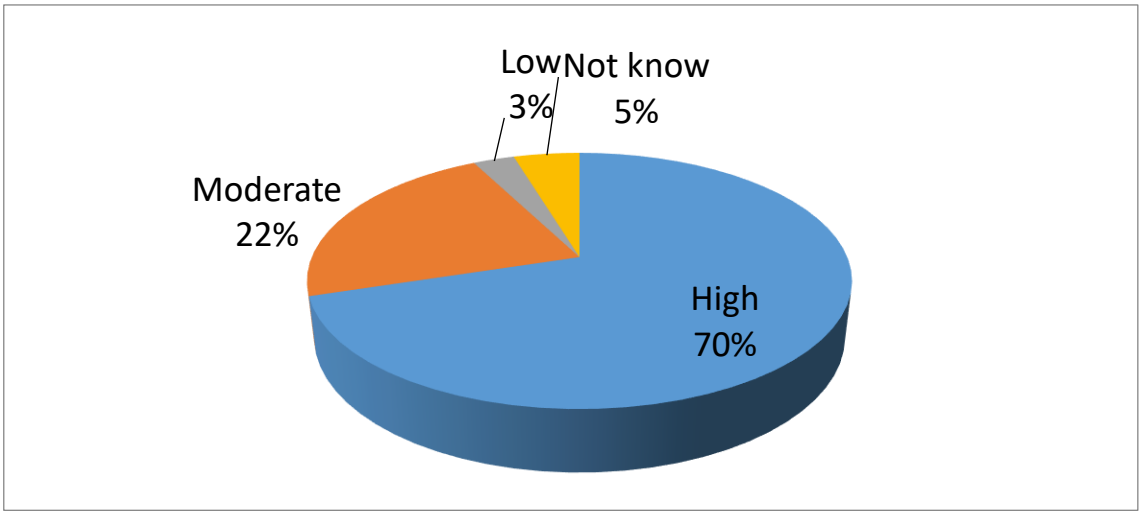

Figure 4 Level of overall agreement on the MSc/PhD course on forest restoration science and research

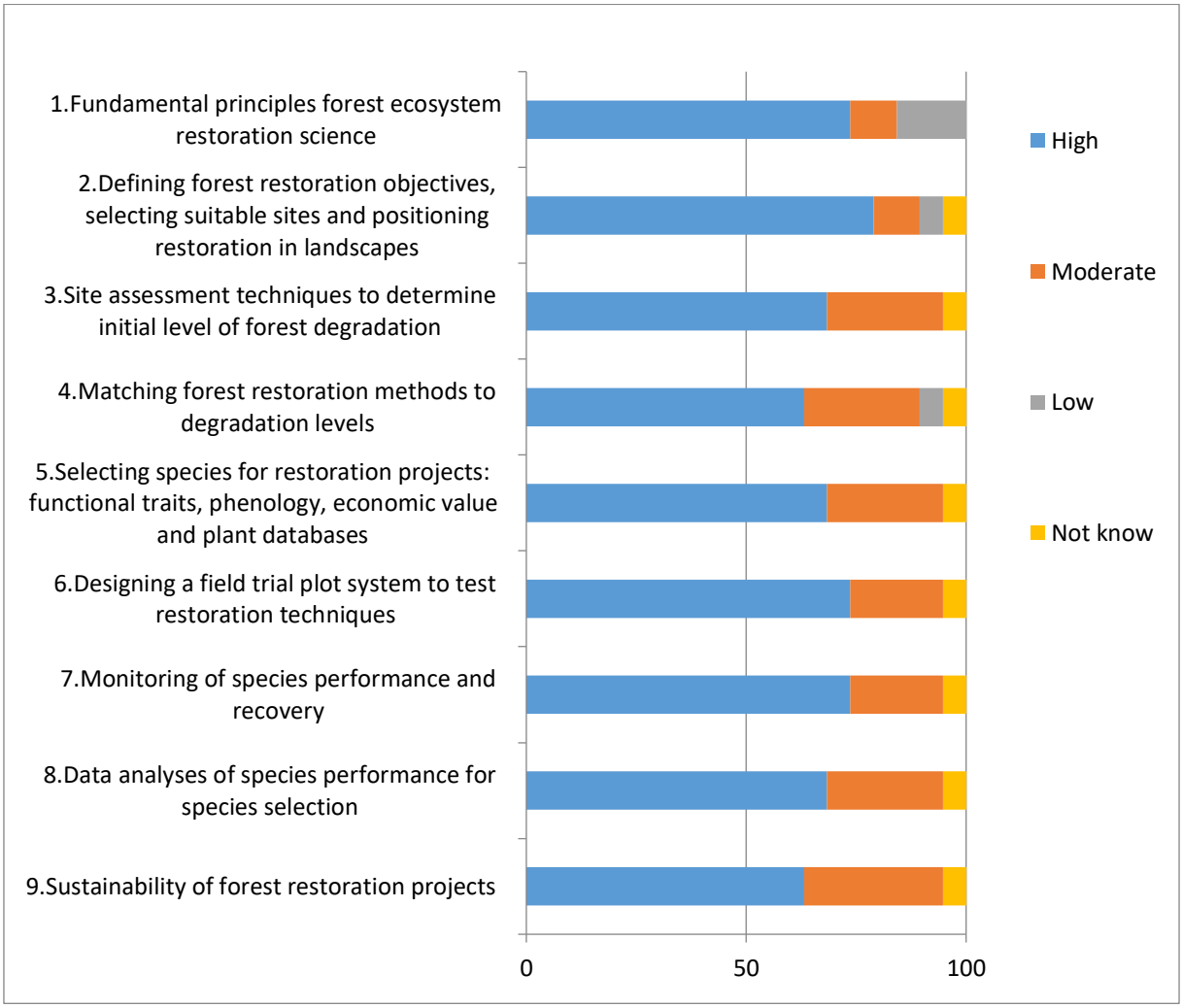

Figure 5 Level of topical agreement on the MSc/PhD course on forest restoration science and research

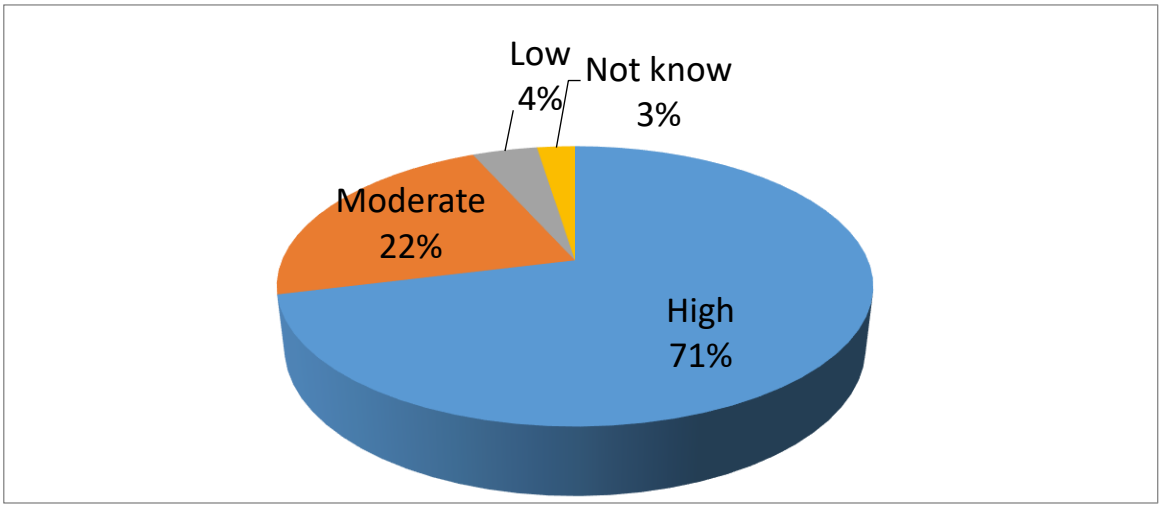

Figure 6 Level of overall agreement on the MOOC course on forest restoration

3. Short description of The Forest Restoration Research Unit (FORRU-CMU) (www.forru.org), Department of Biology, Faculty of Science, Chiang Mai University

FORRU is a small team of ecologists and research students in the Biology Department of Chiang Mai University's Science Faculty. It's mission is to carry out research to develop efficient methods to restore tropical forest ecosystems for biodiversity conservation, environmental protection and carbon storage. FORRU has an education/outreach team, which provides environmental education and technical training, based on FORRU's research outputs, to a wide range of stakeholders and organizations involved in forest restoration. FORRU's philosophy is that tropical forests can be restored, but sound ecological research is essential, to provide science-based skills and knowledge to those most directly affected by deforestation. FORRU actively engages with local people, to integrate biodiversity conservation into the needs of communities, situated in or nearby tropical forests. FORRU believes that if local people have appropriate and sound technical support and are directly involved in all aspects of forest restoration, from planning, to growing and plants trees, they will develop a sense of "stewardship" of restoration projects and will actively participate in caring for and monitoring restore sites, thus reducing the likelihood of subsequent deforestation.

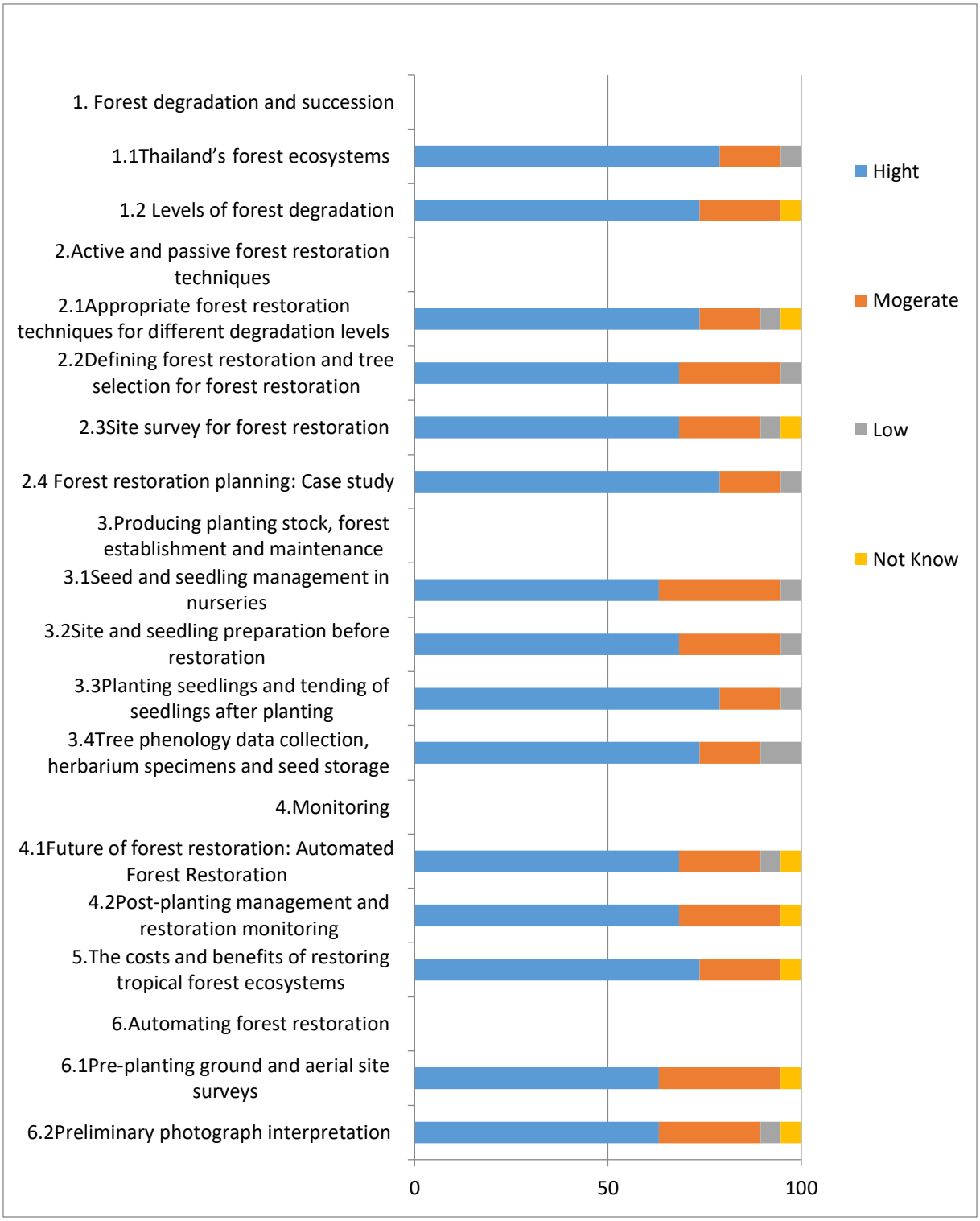

Figure 7 Level of topical agreement on the MOOC course on forest restoration

Table 1 Topic suggestions on the forest restoration courses

Course	Suggestions
BSc course on forest restoration	**Topics related to forest restoration**: policies and laws / stakeholders / examples of financial supports / benefits and ecological services / economic benefit / need assessment / social forest ecology / forest types / use of drone / cultural practices, traditions, announcements, rules, regulations, acts / successful methods / rural livelihood / participatory practical session / experiences from the field
MSc/PhD course on forest restoration science and research	**Topics on forest restoration science and research**: silviculture / government policies / interval ecological assessment / advanced drone flight plans designed for photogrammetry and image processing for 3D models / land laws / land and forest policies / stakeholders / economic dimension / benefits of forest restoration / need assessment for forest restoration / rural livelihood / problem-based learning / seed collection / local participation / laws and policies
MOOC course on forest restoration	**Topics related to forest restoration**: local wisdom / land laws / area management and people living in the forest / land laws, rules and acts / local participation and monitoring / field practice

4. Specific context to consider

In order to ensure 'inclusive and equitable quality education and promote lifelong learning opportunities for all' (Sustainable Development Goal 4, one of the 17 Sustainable Development Goals), educational needs assessments in partner HEIs should be carried out at two levels: (i) the national level; and (ii) the HEI level. The target audience for the national level assessment are the the stakeholder groups, which interact with HEI graduates (either as employers or as partners).

There is a need for upgrading an existing BSc course and opening new MSc/PhD courses on "forest restoration" at CMU. Chiang Mai University's greatest need is to disseminate the science-based restoration techniques, developed by FORRU-CMU, to all stakeholders involved in forest restoration and to enable others (students and interns) to do so, to support global initiatives such as REDD+, the Bonn Challenge, the UN Decade on Restoration etc. Support required includes upgrading staff, with the latest educational techniques and having sufficient financial resources to run courses and workshops, print textbooks, and develop a MOOC to assist project partners to replicate CMU's research and reach out to a wider audience.

5. Material needs assessment

Material needs arise from the academic needs presented by the staff members of FORRU-CMU. FORRU-CMU has some equipment at hand, which could be used in the teaching process, however, the equipment will not be sufficient to cover the number of students that are to be taught within the BSc.

and MSc./PhD. programs. To enable efficient transfer of practical knowledge, FORRU-CMU must purchase several pieces of equipment and software, as stated in Table 2.

- All requested equipment has potential synergies with existing FORRU projects (See project details at: https://www.forru.org/projects), which are 1) Forest restoration for carbon offset for Christian German School Chiang Mai (May 2020 – January 2022), 2) Global tree seed bank program (November 2020 – October 2023), and 3) Forest on Backboard (https://www.forru.org/outreach/forest-on-blackboard).
- Additional synergies for each equipment, if any, are also provided in its row.

Table 2 Equipment needs

Number	Item	Amount	Justification and potential synergies with other projects
- All requested equipment has potential synergies with existing FORRU projects (See project details at: https://www.forru.org/projects), which are 1) Forest restoration for carbon offset for Christian German School Chiang Mai (May 2020 – January 2022), 2) Global tree seed bank program (November 2020 – October 2023), and 3) Forest on Backboard (https://www.forru.org/outreach/forest-on-blackboard). - Additional synergies for each equipment, if any, are also provided in its row.			
1	Binoculars	15	- Justification: Used for tree phenology field observation practices of forest restoration classes. - In one semester, there will be 10 undergraduate and 5 graduate students for forest restoration classes, and 10 FORRU researcher students and interns. In addition, for the whole year, there will be also some undergraduate and graduate students in ecology classes (e.g., basic ecology, plant ecology, tropical ecology, ornithology, behavioural ecology, wildlife conservation, and conservation biology) who can make use of the request equipment.
2	Densiometer	15	-Justification: Used for tree crown measurement for growth monitoring in field practices of forest restoration classes. - In one semester, there will be 10 undergraduate and 5 graduate students for forest restoration classes, and 10 FORRU researcher students and interns. In addition, for the whole year, there will be also some undergraduate and graduate students in ecology classes (e.g. basic ecology, plant ecology, tropical ecology, ornithology, behavioural ecology,

			wildlife conservation, and conservation biology) who can make use of the request equipment.
3	Tree measuring poles	10	-Justification: Used for tree measuring for growth monitoring in field practices of forest restoration classes. - In one semester, there will be 10 undergraduate and 5 graduate students for forest restoration classes, and 10 FORRU researcher students and interns. In addition, for the whole year, there will be also some undergraduate and graduate students in ecology classes (e.g. basic ecology, plant ecology, tropical ecology, ornithology, behavioural ecology, wildlife conservation, and conservation biology) who can make use of the request equipment.
4	Training drone (DJI Mavic AIR 2S)	1	-Justification: Used for field practices in Automated Forest Restoration (AFR) using drones for forest restoration classes. It is suitable for beginners and it is for the first trial drone-flying missions because it is moderately cheaper than other models. This model offers moderate sensor quality. The FRAME project can use this model for teaching how to fly drone. -Additional potential synergies with other activities and projects: Drones support researchers and intern students in field-based experiments.
5	Medium survey drone (DJI Mavic 2 Pro)	1	-Justification: Used for field practices in Automated Forest Restoration (AFR) using drones for forest restoration classes. It has high sensor quality: red, green and blue sensor, which results in image quality to construct orthomosaic images and 3D data. -Additional potential synergies with other activities and projects: Drones support researchers and intern students in field-based experiments.
6	Heavy-lifting drone (DJI MG-1P)	1	-Justification: Used for field practices in Automated Forest Restoration (AFR) using drones for forest restoration classes. It has heavy payload, and the heavy stuffs such as liquid fertilizers, herbicide and fungicide can be carried and applied in sites. This drone is more suitable for intermediate-level pilots who has experience in drone flying. Alternatively, it can be used for doing research in forestry and agriculture by

			adjusted its compartment for another seed/seedling experiment. -Additional potential synergies with other activities and projects: Drones support researchers and intern students in field-based experiments.
7	Large drone (Phantom 4M)	1	-Justification: Used for field practices in Automated Forest Restoration (AFR) using drones for forest restoration classes. It provides multispectral sensors apart from red, green and blude sensor, which are very helpful for vegetation index monitoring, environmental stress condition and plant species identification. Alternatively, this model also supports image bands for soil and water index. -Additional potential synergies with other activities and projects: Drones support researchers and intern students in field-based experiments.
8	Tablet for drones	5	-Justification: Used for field practices in Automated Forest Restoration (AFR) using drones for forest restoration classes. Tablets are needed because there are several drone missions for practicing and planning drone missions. Tablet can be mounted with drone's controllers for tracking drone through all mission plans and for scheduling tasks of each participant. The suggested tablet model has fit screen size to mount on drone controller, which can be approx. 8 inches in size. -Additional potential synergies with other activities and projects: Tablets can also be used for online-based learning and meeting. Moreover, lecturers can use them for organizing class and storing documents or teaching materials.
9	Notebook computer	3	-Justification: Used for field practices in Automated Forest Restoration (AFR) using drones for forest restoration classes. Notebook computers will assist the pre-flight planning. They can be used for aerial photographs taken from drone and subsequently field data collections. Besides, the pre-processing result can be preliminarily tested in the laptops and used giving presentation at professional meetings. The suggested model is suitable for

			field works and for being an office device. Besides, the body is solid, light weight and has long battery time. -Additional potential synergies with other activities and projects: Lecturers can use notebook computers for scoring data entries and assessing files in research.
10	Desktop computer	2	-Justification: Used for field practices in Automated Forest Restoration (AFR) using drones for forest restoration classes. Desktop computers can be used for training students to achieve computational skills from some professional software following with various learning topics. Map production and 3D construction, i.e. forest structures require moderate-high speed hardware in order to handle processing and run photogrammetry approach. Desktop computers are compatible with many choices of processing software, which can be Agisoft Metashape, R Language, CloudCompare, LAStools, and etc., that are fit to basic teaching in MOOC. -Additional potential synergies with other activities and projects: Students will be trained for data management, processing and analysis. FRAME staffs and FORRU-CMU will also use desktop computers for preparing manuscripts for publication.
11	Caliper	1	-Justification: Used for tree measuring for growth monitoring in field practices of forest restoration classes.
12	Camera + Fish-eye lens + tripod	1 each	-Justification: Used for tree crown measurement for growth monitoring in field practices of forest restoration classes.
13	Field generator / Power box	2	-Justification: Used for field practices of forest restoration classes in remote areas.
14	Handheld GPS	2	-Justification: Used for field practices in Automated Forest Restoration (AFR) using drones for forest restoration classes. Spatial data such as vector give details in coordinate, elevation and others. GPS is a key device to derive the spatial data. The spatial data derived from GPS is helpful for drone-based assessment that also provide better accuracy while maps and 3D structure are generating inside the

			photogrammetric software. In addition, students can learn how to use GPS's functions outside the classroom. -Additional potential synergies with other activities and projects: Students can learn how to use GPS's functions outside the classroom. GPS can also be used further in other classes for measuring plot size, tracking pathways and navigation during field observation
15	Clinometer	5	-Justification: Used for tree measuring for growth monitoring in field practices of forest restoration classes.
16	Photogrammetry software	1	-Justification: Used for field practices in Automated Forest Restoration (AFR) using drones for forest restoration classes. It is to keep the idea of using aerial photographs toward completion on remote sensing technique, students and teachers will follow instruction of photogrammetry approach, which will require the operation on license software. The suggested model offers online trainings and instructions, which are freely available online or even on YouTube. Besides, students can learn based on self-practicing by user manuals under lecturer and expert supervision. These bring requests for one-year educational license, which may be extended for another year.
17	Tables for holding equipment in the field	1	-Justification: Used for field work, table should be portable and light weight. Its size should be enough to place all devices such as laptops and drones.
18	Boxes for keeping equipment	5	-Justification: Numbers of boxes are needed for packing all devices and materials. They can be made from high quality of plastic polymers, which is light and can store heavy stuffs as well. We can store equipment and electronic devices during rain falls, and boxes can protect dusts. Boxes can store other equipment after finishing the project.