



Laos People's Democratic Republic
Peace Independence Democracy Unity and Prosperity

Environment Protection Fund

SUB-PROJECT COMPLETION REPORT



Prepared by SDA: Faculty of Natural Science (FNS), National University of Laos (NUOL)

Reviewed by EPFO M&E Officer:

Date Submitted:

Date Reviewed:

Date final report signed off:

I. GENERAL INFORMATION

Sub Project Number: **PICE-LENS2-010**

Sub-project name: Project for Capacity Enhancement of Laos' Natural Science Related to Environmental Protection

Location: National University of Laos and Phou Chom Voy Provincial Protected Area, Bolikhamxay Province

SDA: Faculty of Natural Science (FNS), National University of Laos (NUOL)

Sub Project Manager Name and Contact Information Tel and E-mail:

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Date grant agreement signed: 15 July 2016, (Additional fund 15 January 2020)

Sub-project period signed:

From 15 July 2016	To 31 December 2020
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Sub-project actual implementation period:

From 15 July 2016	To 31 December 2021
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Last period of extension approved:

From 1 January 2021	To 31 December 2021
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Number of time extensions requested: 1

Total budget allocated: 698, 700 USD (including additional fund in 2020)

Total budget received from Project: 694,287 USD

Total Actual Expenditures 694,287 USD

Balance US\$: 4, 413 USD

What will be done with the balance of funds: (Tick one below)

- Return balance to Project
- Others: Purchasing of software for education and research activities

II. SUB-PROJECT IMPLEMENTATION

2.1. Analysis of the Sub-project and status of achievement

List the objectives of the approved proposal and the status of achievement:

Sub-project Objective	Actual Progress Achieved at End of Sub-project	Reasons for non-achieved objective
To strengthen the capacity of Faculty of Natural Sciences to enhance its academic and research programs in subjects related to biodiversity conservation and environmental protection.	The FNS sub-project's all outcomes and output indicators were achieved through the implementation period. It had a very big impact on strengthening of the capacity of faculty of natural sciences, NUOL. The sub-project supported the lecturer to have training/ study tours in 6 foreign universities, upgraded 4 undergraduate curriculums and 1 master curriculum, organized seminars on creating syllabus based on outcome based-education, writing 18 textbooks and provided 22 items of scientific equipment for education and research that benefit 877 students. The sub-project organized a 19 technical training and seminars with a total of 916 participants. The research activities provided opportunities to lecturer, students and local PAFO staff to conduct field research on biodiversity and environment in Phou Chom Voy Provincial protected	(Minimum 50 words)

	<p>area, Bolikhamxay province which had participant of 527 time persons with many new discoveries, especially 536 species of plants (1 new plant species and 5 new plant records of Laos), 226 species of animals, and the unique sea of fog in Phou Chom Voy. The results were published in international and domestic journals. It also supported the establishment of online database on plant and animal, setting a signboard - Area for Scientific Research on Biodiversity and Environment, Phou Chom Voy Provincial Protected Area and Nam Mouane –Nam Gnouang National Protection Forest. With additional fund from 2020, FNS collaborated with faculty of economic and business administration (FEBM) to conduct joint research on establish a model for estimation of economic value of biodiversity ecosystem services in Phou Chom Voy provincial protected area. The research finding was reported to minister and other leaders of ministry of natural resources and environment. The result was also disseminated through several media such as national TV (4 times), Vientiane times newspaper (4 times), video clips on Youtube (4 times), and posters which has contributed to raising awareness of biodiversity and environmental conservation as well.</p>	
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2.2 Analysis of outcomes of the Sub-project and status of achievement

List the outputs/outcomes of the approved proposal and the status of achievement:

Sub-project Outcomes	Actual Achieved indicator at End of Sub-project	Reasons for non-achieved outcomes
<p>1. Increase in the score of functional capacity of SDA's and EPF (annual).</p>	<p>Aggregate Index of functional capacity of the institution was increased from 34 to 46. The annual budget from LENS2 sub-project (259,000USD in 2017 including 157,000USD for scientific equipment / hardware for online database and 143, 290 USD in 2018, 158,315 USD in 2019, 132,000 USD in 2020) contributed to increase the budget of FNS, which increased the index of secure annual budget from 3 to 4. In addition, the FCI on quality staff increased from 2 to 4 due to the increasing of Ph.D. and Master degree holders (86% of total staff) in 2019-2020. This increased the index to 40 in 2017, 42 in 2018, 46 from 2019. The number of papers published in international and domestic journals was 13, 25, and 32 in 2017, 2018, and 2019 respectively. Sub-project supported the field research and 13 research topics in FNS that related to biodiversity and environment in protected area with 17 publications (some are during reviewed process) in international and domestic journals.</p>	<p>(Minimum 40 words)</p>
<p>2. Direct project beneficiaries (of which women) as measured by additional staff of public and partner institutions having completed basic adaptive training (short courses) (cumulative).</p>	<p>The direct project beneficiaries were 916 (female 280) staffs, including 71 staffs in 2017, 125 in 2018, 244 in 2019, 233 in 2020, and 243 staff in 2021. The number of 2017 derived from those included 18 lecturers participated in three batches of training/study tour for upgrade the curriculum (in Thailand and Vietnam), 37 lecturers participated in textbook writing and editing, and 16 staff in seminar on database design. In 2018, 39 lecturers participated in seminar on Lesson plan development, 13 staffs in seminar on analysis of heavy</p>	

	<p>metals in soil and water sample, 16 staffs in seminar on skill in preservation of plant and animal and plant sample. 26 staff in technical seminar with PAFO in Bolikhamxay province. Additional 8 lecturers participated in writing textbooks those were printed in 2019. Twenty in hydrogeology seminar, 35 in seminar on Lesson plan development, and 26 in workshop for dissemination of science research results to technical and villager at Lak Sao. In 2020, 20 staffs were attended seminar on mathematic modeling on environment change, 30 staffs in seminar on using plant and animal database, 16 staff in seminar on data analysis of water and soil quality (Lecturers 16, students 10), 103 staff in Science Conference on Biodiversity and Environment, 64 staff in Current knowledge on Montane forest conservation in Lao PDR. In 2021, 107 staffs in meeting for dissemination of science research and lesson learn sharing with local technical staff and villagers, 67 staff in workshop on data analysis and publication on environmental economic field (FEBM's activity), 69 staff in National workshop on Payment for Environmental Service(FEBM's activity).</p>	
Specific indicator		
1. Improvement of teaching effectiveness of FNS as determined by a third-party analysis (annual).	<p>The baseline was found to be 6.6 in the 2017 assessment. The target is set to be 7.5 in 2020. FNS met the target by implementation of several necessary seminars/workshops and supplying tools including scientific equipment to enhance the faculty capacity. Final assessment was conducted in Q3, 2020 with the score of 7.85.</p>	
2. Number of students benefitted from upgraded curriculums (cumulative).	<p>Number of students benefitted from upgraded curriculums is 877 students including 446 women. In addition to the 4 target curriculums, the text books and equipment were also used by other curriculum's students in each department that share the same subject with the upgrade curriculum.</p> <p>The scientific equipment (18 items) were delivered during August to early December, 2017. Students used the equipment from Q4, 2017. Besides equipment were used in the classes, at least 58 students received benefit from using Atomic Absorption Spectrometer for heavy metal analysis and HPLC for their thesis research. This included 2 students from department of environment, faculty of agriculture and environment, Savannakhet University.</p>	
3. Number of papers / report/ proceeding on natural science research related to environment protection to be published in domestic and international journals / meetings (cumulative).	<p>A total of 12 times of field research was conducted during Q4 of 2017 and Q1 of 2021. A total of 17 papers were submitted for publication in domestic and international journals. Five papers have been published in international journals. A total of 54 proceeding/reports have been presented at several scientific and technical conference/meeting/seminars. The animal and botanical survey team submitted 3 abstracts to 2nd Annual National Biodiversity Conference. Nine research topics were published in proceeding for a science meeting with Bolikhamxay</p>	

	<p>province. Three topics were report at the International Research Forum on Science, technology and Innovation (2019). Other reports including 12 proceeding in Science Conference on Biodiversity and Environment (2020), 12 proceeding in National Research Forum on Science, Technology and Innovation (2020), 2 proceedings in FNS Scientific conference 2020, 2 topics were presented at modeling workshop held by Natural Resources and Environment Research Instituted, MONRE (2020), 5 research topics on animal and botanical were presented in national workshop “Current Knowledge on Montane Forest Conservation in Lao PDR” (2020), 3 topics were presented at 4th National Biodiversity Conference (2021), 2 topics at NUOL science conference 2021, and 1 topic in the workshop on evaluation of ecosystem service of Phou Chom Voy Provincial Protected Area.</p>	
<p>4. Number of NUOL FNS students to co-author published scientific journal articles (cumulative).</p>	<p>Students in biology department conducted 21 biology research topics for their thesis related to biodiversity in Phou Chom Voy, Other’s several students in other department also participated in the research activities. Their name were put as co-author of several proceeding and abstract for conference.</p>	
<p>5. Number of public participants in NUOL FNS scientific awareness raising activities (Dong Dok Campus & local level villages) (cumulative).</p>	<p>Number of public participants in NUOL FNS scientific awareness raising activities reached 3130 people. Awareness rising posters on 9 topics were created and distributed to concern authorities in bolikhamxay province. The numbers are estimated from PAFO 100, Khamkherd and xaychamphone district 250, DAFO 100, 2 villages 500, Exhibition in LaoTechMart in 2018. In 2019, research results were disseminated at the cerebration events of World Environment Day at FES 100, at the International Research Forum on Science, Technology and Innovation for Sustainable Development at NUOL 320, posters 9 topics distribute to PAFO, 2 Districts, Khamkert DAFO, 1 village (370). In addition, news on technical meeting for dissemination of science research result at Phou Chom Voy to local technical staff and villagers was broadcasted on Bolikhamxay province's TV and posted on TV station's face book website which obtained 4100 view (this number are not included here). 145 time person of villagers participated in field survey during 2017 to 2021. In 2021FNS held a meeting to disseminate research activities for women union at Lao which 45 staff were joined and did study tour at herbarium and laboratories of FNS. A total of 145 villagers joined the field survey during 2017-2021.</p> <p>In addition, the news of conference on biodiversity and environment (2020) was broadcasted on National TV news. The FNS sub-project activities and finding a new plant species were broadcasted on a national TV program and YOUTUBE for 33 minutes. Vientiane Times newspaper reported botanical team and news of workshop on Current Knowledge on Montane Forest in Lao PDR. Lao Youth Radio (90.0 MHz) also reported the news of new plant species discovery by FNS team. The activities of FNS and FEBM in 2021 have been disseminated to the publics through several media such as National and local TV news, Vientiane times</p>	

	newspaper, local newspaper and website, Facebook and YOUTUBE. This could increase awareness on biodiversity and environment protection. It is also spread the news of FNS activities to the public.	
6. "Deliverables" proposed in the AWPB completed each year (annual).	The sub-project completed 80% -97 % of the AWPB each year except 71% in 2020 due to COVID-19 pandemic measures.	
7. Models for Total Economic Value of Biodiversity Ecosystem Services in Phou Chom Voy Protected Area	The FNS's field works were completed. FEBM created a model for total economic value of biodiversity ecosystem services in Phou Chom Voy protected area	
8. Number of papers / report/ proceeding on economic value of biodiversity ecosystem services be published in domestic and international journals / meetings (cumulative)	The number of papers / report/ proceeding on economic value of biodiversity ecosystem services be published in domestic and international journals / meetings was 6. FNS published 1 paper in international journal. FNS and FEBM reported 2 topics in modeling workshop organized by NRERI, MONRE. FEBM reported 3 topics in the seminars of direct and indirect use of Phou Chom Voy Provincial Protected Area.	
9. Field guidebooks regarding diversity of ecosystems (floristic character and vegetation), diversity of flora species, and diversity of fauna in Phou Chomvoy Protected area	Field guidebooks on animal, and flora and vegetation of Phou Chom Voy PPA were written and published in 2021	

2.3 Analysis of Outputs of the Sub-project and status of achievement

List the outputs/outcomes of the approved proposal and the status of achievement:

Planned Sub-project Outputs	Actual Achieved indicator at End of Sub-project	Reasons for non-achieved outputs
a. 70 teachers in Faculty of Natural Science will be strengthening their knowledge and skills in curriculum development and improvement.	A total of 216 time person (female 74) in faculty of natural sciences were participated in training/workshop to improved their knowledge and skills in curriculum development and improvement. Three batches (18 lecturers) of training/study tours for upgrading of 4 curriculums and development of 1 curriculum were organized in universities in Thailand and Vietnam in March, 2017. Writing and Printing of Nine text books were completed. A total of 45 lecturers (women 23) participated in writing and editing of 18 textbooks in 2017 and 2019. The 2 batches of workshop to enhance the teacher capacity in developing lesson plans and curriculum improvement was held on April 28-29th, 2018 with 39 trainees (female 14) and on 17-18 August, 2019 with 35 Thirty five lecturers from 4 targeted curriculum. Sub-project received 40 subjects of lesson plan from 4 courses and were reviewed at the meeting for approval of the lesson plan that was held during 23-26 September, 2019. A total of 87 lecturers were participated in targeted 4 curriculum's lesson plan approval.	(Minimum 40 words)

<p>b. 200 students per year (800 students in the project period) will study in the improved and developed curriculum related to environmental protection.</p>	<p>The new syllabus (lesson plan) were upgraded in 2017 and 2019 and partially used by lecturers in related curriculum. The students also benefited from using the text books supported by the sub-project. The target 5 curriculums are bachelor of science program in biology, environmental chemistry, physics, geophysics, and master of science program in chemistry. In addition to the target curriculums, the text books and equipment were also used by students in other curriculum (general chemistry, biotechnology, material physics. that share the same subject with the upgrade curriculum. Number of students benefitted from upgraded curriculums including of scientific equipment is 877 students including 446 women.</p>	
<p>c. 3000+ people will learn about natural science in environmental protection in awareness raising seminars hosted by NUOL FNS.</p>	<p>Number of public participants in NUOL FNS scientific awareness raising activities was estimated to reach 3130 people. The numbers are estimated from awareness rising activities, exhibition, meeting, and number of villagers participated in research activities at Phou Chom Voy Provincial protected area posters on 9 topics were created and distributed to concern authorities in Bolikhamxay province. In addition, the news of conference on biodiversity and environment (2020) was broadcasted on National TV news. The FNS sub-project activities and finding a new plant species were broadcasted on a national TV program and YOUTUBE for 33 minutes. Vientiane Times newspaper reported botanical team and news of workshop on Current Knowledge on Montane Forest in Lao PDR. Lao Youth Radio (90.0 MHz) also reported the news of new plant species discovery by FNS team. The activities of FNS and FEBM in 2021 have been disseminated to the publics through several media such as National and local TV news, Vientiane times newspaper, local newspaper and website, Facebook and YOUTUBE. This could increase awareness on biodiversity and environment protection. It is also spread the news of FNS activities to the public.</p>	
<p>d. 4 undergraduate's degree and 1 master's degree curriculums related to biodiversity and environmental protection will be improved or developed.</p>	<p>Document on upgrading of 4 curriculums and development of master degree curriculum was drafted and revised after the foreign universities' visit in March, 2017. Master degree program in chemistry was approved by MOES in October, 2017.</p> <p>Four undergraduate curriculums were reviewed by the university's technical committee in November 2018. In 2019, NUOL adopted new guideline on curriculum upgrading to follow the outcome-based education. The 4 upgraded curricula were revised and submitted to NUOL. NUOL sent the approval request to MOES in October 2020 and it is approved by MOES on December 7, 2020.</p> <p>The Master program was opened in March, 2018. A total of 30 students were enrolled in the program (11 students</p>	

	in 2018, 12 students in 2019, 7 students in 2020). This number included 15 government staffs (Bolikhamsay's PAFO, MOIC, MONRE, MOH, Vientiane DOIC, University of Health, Souphanouvong University, NUOL and High school lecturers). Seven students graduated in February, 2020.	
e. 18 textbooks subjects on natural science related to environment protection will be published with a quantity of 1,800 copies, which will be useful for teachers and students.	The textbooks were written by assigned lecturers in the faculty in 2 batches and printed in 2017 and 2019. The subjects are Mycology, Comparative animal physiology, Biodiversity, Applied microbiology, Ecology, Plant Taxonomy, Air pollution and Air quality Management, Soil Pollution from Chemicals Use, Technique in Water quality analysis, Environment Impact Assessment, Analytical Chemistry 1, Waste Management, Pollutant Analysis Technique, Renewable energy, Sustainable energy, Solar cell, Geoelectric Prospecting, Magnetic Prospecting	
f. 100 scientific researchers will have their methods and techniques upgraded through targeted training seminars.	A total of 700 people were participated in technical seminars, training, workshops and conference organized by FNS and FEBM. FNS organized 13 seminars/meetings/ conference (564 participants, female 159) including a national seminar on "Current knowledge on Montane forest conservation in Lao PDR" and FEBM organized 2 workshops (136 participants) including a national workshop on Payment for Environmental Service.	
g. Large amount of scientific equipment (~\$130,000) for upgrading NUOL FNS teaching laboratories.	The 11 items of scientific equipment for upgrade teaching laboratory include Atomic Absorption Spectrophotometer, High Performance Liquid Chromatography, ED Biological Microscope, Stereomicroscope, Hot air oven, Incubator, Vortex/Mixer, Water Bath Shaker, Stereomicroscope, Server Computer, Full Automatic Microtome mainly used by department of biology and department of chemistry.	
h. Large amount of scientific research equipment (~\$40,000) for study in the national protected area.	The 11 items of scientific research equipment for study in the national protected area included Moisture Meter, Multiparameter Water Quality Monitor, Water Flow meter, Data logger, Humidity meter, Pyranometer, Hygrometer, Camera for fungi study, Camera and lens for animal observation, Night Vision Scope, Camera trap	
i. Scientific data on biodiversity and environmental quality from Hin Nam No National Protected Area will be obtained and contributed to upgrade it as ASEAN heritage park.	Because several other international and national organization conduct research and management activities in Hin Namno National Protected Area and data are available, FNS team had change to research target to Phou Chom Voy Provincial Protected area in Bolikhamsay province, where is lack of the information. Since November 2017, the FNS team conducted research on biodiversity and environment in 6 subjects such as diversity of animals including mammals, birds, amphibians-reptiles, aquatic animals, diversity of plants and fungi, water and soil quality, hydrogeology and	

	<p>natural radiation, solar intensity, and environmental change by using mathematic modeling.</p> <p>The teams were able to get a lot of scientific information. The botanical team found the different botanical community characteristic such as bamboo forest, montane evergreen forest, did sampling and classification of plants to be 122 genera with 536 species. The team found new botanical species and named <i>Begonia Phouchomvoyensis</i>, 1 new family record, and 4 new records of Laos, which have been published in international Journals.</p> <p>The team also found a flower <i>Sapria himalayana</i>, a rare flower species in Lao PDR. The fungi survey team collected 261 samples of mushrooms and 145 species were analyzed. The animal survey team found a total of 226 animal species, such as 29 species of mammals, 36 species of amphibians, 16 species of reptiles, 50 species of birds, 45 species of fish, 28 species of insects, 22 species of invertebrates and plankton including the endanger and rare wildlife. The team set the camera trap to take photos of wildlife three times. In addition, the FNS teams also collected the environmental information such as hydrological and water system data, geographical data, solar intensity, natural radiation, water and soil quality data, and environmental change trends in the Phou Chom Voy area.</p>	
<p>j. Lao will have wildlife database that can search and update online</p>	<p>The database of plants and animals was developed. The database of plants and animals is divided into 2 parts: the Back-end for researchers and administrators at various levels to deal with information, which management systems can handle basic information in the system such as data management, plant and animal information management, researcher data management, management of user at various levels and others. The second part is the front-end page for general users, who can access information such as the results of scientific research, search data research according to the required conditions, can download some information to use the rights set by the system administrator.</p> <p>This system has been developed as a Web Application developed with CodeIgniter Framework, using the PHP programming language, using MySQL as the database to store research data.</p>	

2.4. Status of the institutional arrangements

Please present the implementation arrangements that were established to carry out the Sub-project implementation in coordination and cooperation with other stakeholders. It may include capacity improvement and/or challenges within the SDA.

- The FNS assigned the committee to take responsible for project implementation. The committee consisted of project advisor (dean), project director, technical team, accountant team, monitoring evaluation and cash keeping team, procurement team, coordination team including 5 people from 5 departments and 1

person for coordination with other stakeholder, research team leaders (9 people) and 63 research team members.

- All 5 departments of the faculty have involved and responsible for their assigned activities such as conducting research and organizing of meetings/workshop/seminars. The sub project provided lecturers/researchers the opportunities to strengthen their capacity thorough participation in training, workshop, conference, field research, and cooperation with other stakeholders.
- As an research activities of the sub project, FNS officially signed a partnership contract with Bolikhamxay PAFO to conduct research in Phou Chom Voy Provincial protected area. Bolikhamxay PAFO had assigned a coordinator for the sub project. The official cooperation between 2 institutions is a crucial factor for local authority's cooperation and successful implementation of the research activity at Phou Chom Voy protected area.
- FNS management team also learnt many lessons from other 4 faculties' sub projects. Several FNS's researchers had joined and gave presentation in biodiversity conferences hosted by Faculty of Forestry Science. FNS had discussion and collaboration with FFS and Faculty of Economic and Business Administration (FEBM) for additional funding proposal. FNS and FEBM submitted the joint-research proposal and implement research on assessment of economic value of biodiversity and environment of Phou Chom Voy Provincial protected area. Several seminars/workshop were organized and increased the collaboration between FNS and FEBM.

2.5. Implementation of Sub-project component and achievements of outputs

This section shall describe each actual activity, its achievement and provide details of the outputs in the Annex section.

Activities for Output 1: _ 70 teachers in Faculty of Natural Science will be strengthening their knowledge and skills in curriculum development and improvement.

- A total of 216 time person (female 74) in faculty of natural sciences were participated in training/workshop to improved their knowledge and skills in curriculum development and improvement.
- Three batches (18 lecturers) of training/study tours for upgrading of 4 curriculums and development of 1 curriculum were organized in universities in Thailand and Vietnam in March, 2017. The lecturers could compare current curriculums with those of the other universities. Draft for improvement of each curriculum and development was created. In addition, each university was welcome for future collaboration in academic exchange, curriculum development, researcher and student exchange.
- Writing and Printing of Nine text books were completed. A total of 45 lecturers (women 23) participated in writing and editing of 18 textbooks in 2017 and 2019. The text books were delivered to each department following the guidance of FNS and use by lecturer and students. The student could use the textbooks from Q4, 2017.
- The 1st batch of workshop to enhance the teacher capacity in developing lesson plans and curriculum improvement was held on April 28-29th, 2018 with 39 trainees (female 14) and 2 speakers participated. The NUOL's head of technical department, gave a talk on Lao and NUOL's education strategy, problem in curriculum assessment, challenging in implementation of curriculum to meet Asean University Network (AUN) standard etc. The 2nd speaker introduced and described about the several lesson plan formats that he had trained from MOES and other donors. The discussion and agreement on choosing the format were made. Each participant did practice to write his/her lesson plan and had to complete at least one lesson plan at the workshop. Draft on improvement of 4 curriculum was also introduced and discussed in the workshop.
- The 2nd batch of workshop on developing lesson plans and curriculum improvement was held on 17-18 August, 2019. Thirty five lecturers from 4 targeted curriculum was participated. The two trainers from NUOL academic office and FNS academic division did a presentation for the new rule and guidelines on curriculum development and evaluation, how to transfer credit and change majors, the format of lesson plan and the way to develop following the revised guidelines of NUOL. The workshop was opened for discussion and guided participant to develop at least one lesson plan at the workshop.

- Sub-project received 40 subjects of lesson plan from 4 courses and were reviewed at the meeting for approval of the lesson plan that was held during 23- 26 September, 2019. A total of 87 lecturers were participated in targeted 4 curriculum's lesson plan approval. The after main meeting, separated meeting was held for each curriculum.

Activities for Output 2:

200 students per year (800 students in the project period) will study in the improved and developed curriculum related to environmental protection.

- Due to NUOL adopt new guidelines to transition to outcome-based education, it took more than 3 years on the process to get MOES's approval for using upgrading curriculum with several revision. However, the new syllabus (lesson plan) were upgraded in 2017 and 2019 and partially used by lecturers in related curriculum. The students also benefit from using the text books supported by the sub-project. The target 5 curriculums are bachelor of science program in biology, environmental chemistry, physics, geophysics, and master of science program in chemistry. In addition to the target curriculums, the text books and equipment were also used by students in other curriculum (general chemistry, biotechnology, material physics. that share the same subject with the upgrade curriculum. Number of students benefitted from upgraded curriculums is 877 students including 446 women.
- The scientific equipment (18 items) were delivered during August to early December, 2017. Students used the equipment from Q4, 2017. Besides equipment were used in the classes, at least 58 students received benefit from using Atomic Absorption Spectrometer for heavy metal analysis and HPLC for their thesis research. This included 2 students from department of environment, faculty of agriculture and environment, Savannakhet University.

Activities for Output 3:

3000+ people will learn about natural science in environmental protection in awareness raising seminars hosted by NUOL FNS.

- Number of public participants in NUOL FNS scientific awareness raising activities was estimated to reach 3130 people. Awareness rising posters on 9 topics were created and distributed to concern authorities in Bolikhamxay province. The numbers are estimated from PAFO 100, Khamkheuth and Xaychamphone districts 250, DAFO 100, 2 villages 500, 10 days exhibition in LaoTechMart (1000) in 2018. In 2019, research results were disseminated at the celebration events of World Environment Day at FES 100, at the International Research Forum on Science, Technology and Innovation for Sustainable Development at NUOL 320, posters 9 topics distribute to PAFO, 2 Districts, Khamkert DAFO, 1 village (370). In addition, news on technical meeting for dissemination of science research result at Phou Chom Voy to local technical staff and villagers was broadcasted on Bolikhamxay province's TV and posted on TV station's face book website which obtained 4100 view (this number are not included here). 145 time person of villagers participated in field survey during 2017 to 2021. In 2021FNS held a meeting to disseminate research activities for women union at Lao which 45 staff were joined and did study tour at herbarium and laboratories of FNS. A total of 145 villagers joined the field survey during 2017-2021.
- In addition, the news of conference on biodiversity and environment (2020) was broadcasted on National TV news. The FNS sub-project activities and finding a new plant species were broadcasted on a national TV program and YOUTUBE for 33 minutes. Vientiane Times newspaper reported botanical team and news of workshop on Current Knowledge on Montane Forest in Lao PDR. Lao Youth Radio (90.0 MHz) also reported the news of new plant species discovery by FNS team. The activities of FNS and FEBM in 2021 have been disseminated to the publics through several media such as National and local TV news, Vientiane times newspaper, local newspaper and website, Facebook and YOUTUBE. This could increase awareness on biodiversity and environment protection. It is also spread the news of FNS activities to the public.

Activities for Output 4:

4 undergraduate's degree and 1 master's degree curriculums related to biodiversity and environmental protection will be improved or developed.

- Document on upgrading of 4 curriculums and development of master degree curriculum was drafted and revised after the foreign universities' visit in March, 2017. Master degree program in chemistry was approved by MOES in October, 2017.
- Four undergraduate curriculums were reviewed by the university's technical committee in November 2018. In 2019, NUOL adopted new guideline on curriculum upgrading to follow the outcome-based education. The 4 upgraded curricula were revised and submitted to NUOL. NUOL sent the approval request to MOES in October 2020 and it is approved by MOES on December 7, 2020.
- The Master program was opened in March, 2018. A total of 30 students were enrolled in the program (11 students in 2018, 12 students in 2019, 7 students in 2020). This number included 15 government staffs (Bolikhamxay's PAFO, MOIC, MONRE, MOH, Vientiane DOIC, University of Health, Souphanouvong University, NUOL and High school lecturers). Seven students graduated in February, 2020.

Activities for Output 5:

18 textbooks subjects on natural science related to environment protection will be published with a quantity of 1,800 copies, which will be useful for teachers and students.

- The textbooks were written by assigned lecturers in the faculty in 2 batches and printed in 2017 and 2019. The subjects are Mycology, Comparative animal physiology, Biodiversity, Applied microbiology, Ecology, Plant Taxonomy, Air pollution and Air quality Management, Soil Pollution from Chemicals Use, Technique in Water quality analysis, Environment Impact Assessment, Analytical Chemistry 1, Waste Management, Pollutant Analysis Technique, Renewable energy, Sustainable energy, Solar cell, Geoelectric Prospecting, Magnetic Prospecting. Printing were 100 copies for each textbook with the total of 1,800 copies.

Activities for Output 6:

100 scientific researchers will have their methods and techniques upgraded through targeted training seminars.

- A total of 700 people were participated in technical seminars, training, workshops and conference organized by FNS and FEBM. FNS organized 13 seminars/meetings/ conference (564 participants, female 159) including a national seminar on "Current knowledge on Montane forest conservation in Lao PDR" and FEBM organized 2 workshops (136 participants) including a national workshop on Payment for Environmental Service.

Activities for Output 7:

Large amount of scientific equipment (~\$130,000) for upgrading NUOL FNS teaching laboratories.

- The 11 items of scientific equipment for upgrade teaching laboratory include Atomic Absorption Spectrophotometer, High Performance Liquid Chromatography, ED Biological Microscope, Stereomicroscope, Hot air oven, Incubator, Vortex/Mixer, Water Bath Shaker, Stereomicroscope, Server Computer, Full Automatic Microtome mainly used by department of biology and department of chemistry.
- Activities for Output 8: Large amount of scientific research equipment (~\$40,000) for study in the national protected area.

Activities for Output 9:

Scientific data on biodiversity and environmental quality from Hin Nam No National Protected Area will be obtained and contributed to upgrade it as ASEAN heritage park.

- Since several other international and national organization conduct research and management activities in Hin Namno National Protected Area and data are available, FNS team had change to research target to

Phou Chom Voy Provincial Protected area in Bolikhamxay province, where is lack of the information. Since November 2017, the FNS team conducted research on biodiversity and environment in 6 subjects such as diversity of animals including mammals, birds, amphibians-reptiles, aquatic animals, diversity of plants and fungi, water and soil quality, hydrogeology and natural radiation, solar intensity, and environmental change by using mathematic modeling. The teams were able to get a lot of scientific information. The botanical team found the different botanical community characteristic such as bamboo forest, montane evergreen forest, did sampling and classification of plants to be 122 genera with 536 species. The team found new botanical species and named *Begonia Phouchomvoyensis*, 1 new family record, and 4 new records of Laos, which have been published in international Journals. The team also found a flower *Sapria himalayana*, a rare flower species in Lao PDR. The fungi survey team collected 261 samples of mushrooms and 145 species were analyzed. The animal survey team found a total of 226 animal species, such as 29 species of mammals, 36 species of amphibians, 16 species of reptiles, 50 species of birds, 45 species of fish, 28 species of insects, 22 species of invertebrates and plankton including the endanger and rare wildlife. The team set the camera trap to take photos of wildlife three times. In addition, the FNS teams also collected the environmental information such as hydrological and water system data, geographical data, solar intensity, natural radiation, water and soil quality data, and environmental change trends in the Phou Chom Voy area.

Activities for Output 10:

Lao will have wildlife database that can search and update online

- The database of plants and animals was developed. The database of plants and animals is divided into 2 parts: the Back-end for researchers and administrators at various levels to deal with information, which management systems can handle basic information in the system such as data management, plant and animal information management, researcher data management, management of user at various levels and others. The second part is the front-end page for general users, who can access information such as the results of scientific research, search data research according to the required conditions, can download some information to use the rights set by the system administrator.
- This system has been developed as a Web Application developed with CodeIgniter Framework, using the PHP programming language, using MySQL as the database to store research data.

2.6. Major constrains/problems encountered in Sub-project implementation

List down problems encountered and action taken to overcome those problems

Problems Encountered in Implementation	Actions Taken to Solve Problems
1. There was a bit delay in procurement of scientific equipment at the first stage of sub project implementation, but it was not affected project activities. It took a long time in preparing and checking specification with EPF due to limited experience on design and preparation of specification of scientific equipment and hardware for online database.	- Communication with procurement team of EPFO frequently.
2. Some difficulty to conduct activities due to change of payment rules. Due to the issuance of decision 4000/MOF, sub-project could not pay for some activities as planned before.	- Re-allocated the budget and changed the way of calculation to follow the decision.
3 Some difficulty to conduct activities due to change of payment rules and measures on COVID-19 pandemic. - Some technical books writing activity has been pending in 2020 due to notification of World Bank on the decision 4000/MOF. The issue was solved in Q4, 2020. This activity was implemented in 2021. - Several field survey and meetings were postponed due to measures against COVID-19 pandemic.	- Communication and discussion with EPFO to find the way how to solve the problem.

<p>4 Some difficulty to conduct activities due to measures on COVID-19 pandemic.</p> <ul style="list-style-type: none"> - Several field survey and meetings were postponed due to measures against COVID-19 pandemic. 	<ul style="list-style-type: none"> - Consulted with EPFO for extend the sub project's period. - Conducted activities when the situation getting good - Re-allocated some budget for purchasing of equipment for video conference
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III. FUTURE PLAN AND DIRECTION

This section describes the plan (including follow up plan or proposal, scale up, replication) to sustain Sub-project in the future. How to achieve it and who will do it.

- It is necessary to continue research activities and expand the research activities to other location to support the management and protection of biodiversity and environment in Lao PDR. The capacity of the lecturers and researchers has been enhanced in this sub project and it should be sustained and improved to be higher level with high quality in the future.
- This research was limited to some area of Phou Chom Voy that is provincial protected area. We wish to do research and survey in other location where the team could not reach and in the Nam Mouane –Nam Gnouang National Protection Forest near Vietnam border side when we have available funding in the future.
- The scientific researches as biological and physical properties should be continued and expanded to other locations in the country to provide scientific information for the management and protection of biodiversity and environment in Lao PDR.
- Some scientific equipment for research were provided in this sub project. However, it is still in limited items and numbers due to limited budget. It is necessary to have more scientific equipment for research to upgrade the research capacity to higher level with high quality.
- From this sub project, FNS obtained experience in dissemination of research results to the public through several channels, especially through TV and Youtube. FNS would like to make documentary of Phou Chom Voy and other story to increase the awareness of people on protection of biodiversity and environment.

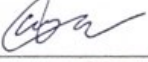
IV. CONCLUSIONS


- The FNS sub-project's all outcomes and output indicators were achieved through the implementation period.
- The sub project provided the opportunities for lecturers, teachers and students to take training, organize and participate in technical workshop, seminars, conference to increase the capacity in improvement of curriculum and research activities. The sub-project organized a 19 technical training and seminars with a total of 916 participants.
- The subproject supported the upgrade of 4 bachelor curriculums and establishment of 1 master curriculum, and supported writing of 18 textbooks and provided 22 items of scientific equipment for education and research that benefit 877 students.
- The research activities provided opportunities to lecturer, students and local PAFO staff to conduct field research on biodiversity and environment in Phou Chom Voy Provincial protected area, Bolikhamxay province. The research team found many interesting results, especially discovery of 536 species of plants (1 new plant species and 5 new plant records of Laos), 226 species of animals, and the unique sea of fog in Phou Chom Voy.
- In addition, the FNS teams also collected the environmental information such as hydrological and water system data, geographical data, solar intensity, natural radiation, water and soil quality data, and environmental change trends in the Phou Chom Voy area. The results were published in international and domestic journals.

- The sub project supported the establishment of online database on plant and animal, setting a signboard - Area for Scientific Research on Biodiversity and Environment, Phou Chom Voy Provincial Protected Area and Nam Mouane –Nam Gnouang National Protection Forest.
- With additional fund from 2020, FNS collaborated with faculty of economic and business administration (FEBM) to conduct joint research on establish a model for estimation of economic value of biodiversity ecosystem services in Phou Chom Voy provincial protected area.
- The research finding was reported to leaders of MONRE, Bolikhamxay province, and NUOL. The research results was also disseminated through several media such as national TV, Vientiane times newspaper, video clips on Youtube, and posters which has contributed to raising awareness of biodiversity and environmental conservation as well.

V. RECOMMENDATIONS BASED ON LESSONS LEARNED

- a. What should be done in the future?
1. Improve facilities and scientific equipment for education and research in FNS/NUOL.
 2. Continue to conduct research in Phou Chom Voy and expand to Nam Mouane –Nam Gnouang National Protection Forest near Vietnam border side.
 3. Create documentary video to describe about Phou Chom Voy and other animals will increase the awareness on protection of biodiversity and environment.
 4. Since there is lack of the scientific information to support biodiversity and environment management and protection in Laos, continuous funding to support for scientific research in Laos is needed.
 5. Establish the center for scientific research on biodiversity and environment in Phou Chom Voy PPA
 6. Study the possibility of ecotourism in Phou Chom Voy PPA
 7. It is necessary to have long term planning for study the effect of climate change on the biodiversity and environment in protected area.
 8. Provide more opportunity for local staff and villagers to get involve in the research activities.
- b. What should be avoided in the future?
1. Avoid the vehicle that not suitable for field work, especially in the rainy season due to bad condition of the road in Phou Chom Voy area
 2. Since field research activities need the collaboration of local peoples, we have to avoid some activities that will have adverse impact on tradition and protection of local cultures.
 3. Avoid leaving the plastic waste and fire in the research field. All plastic waste should be taken back. Pay attention to turn off the fire when leaving the camp.
- c. General recommendations
1. Keep periodically communication with EPF, World Bank and other stakeholders
 2. Request official cooperation with other institution at the first stage of sub project implementation
 3. _____

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 Date: 28/2/2022

Approved by: 

 Date: Assoc. Prof. Dr. Bounphan TONPHENG
28/2/2022



Annex 2a. FNS-Result Framework Report, update on 31 December 2021

Project Development Objective (PDO)		To help strengthen selected environmental protection management systems, specifically for protected areas conservation, enforcement of wildlife laws, and environmental assessment management.													
Sub-project objective (SPO)		To strengthen the capacity of faculty of Natural Sciences to enhance its academic and research programs in subjects related to biodiversity conservation and environmental protection.													
Indicators	Unit		Baseline	Annual Target Values						Reporting Frequency	Data Source/ Methodology	Resp. for Data Collection	Responsible for Data Analysis and Reporting	Description (indicator definition)	Remarks
				FY16	FY17	FY18	FY19	FY20	FY21						
Subproject related indicators - PDO Level															
Aggregate Index of functional capacity of the institution (annual)	%	Plan	34	34	34	38	42	46	46	Annual	Index score sheet filled out by the FNS Faculty based on a max score of 100%	Faculty of Natural Science	Faculty of Natural Science	Data used to calculate this figure included in the Capacity Index spreadsheet (attached)	The annual budget from Lens2 sub-project contributed to increase the budget of FNS. In addition, the FCI on quality staff increased from 2 to 4 due to the increasing of Ph.D. and Master degree holders. Publication was increased to 32 papers during 2019-2020
		Revised plan													
		Actual		34	40	42	46	46	46						
Improvement of teaching effectiveness of FNS as determined by a third-party analysis (annual)	#	Plan	NA	NA	-	NA	-	NA	-	Annual	Teaching performance assessment by third party	Faculty of Natural Science	Faculty of Natural Science	The baseline will be determined in Year 1	Baseline was analyzed by third party in 2017. Baseline is 6.5 in 10. Assessment in 2018 and 2020 gave 6.9 and 7.85, respectively.
		Revised plan			6.5	6.8		7.5	-						
		Actual			6.5	6.9		7.85							
Sub-Project related Intermediate Outcome Indicators															
Component 1 - Developing and Upgrading of Curriculums															
Direct project beneficiaries (of which women) as measured by additional staff of public and partner institutions having completed basic adaptive training (short courses) (cumulative).	#	Plan	0	0	48	68	118	118	471	Annual	Training records, meeting records, travel records	Faculty of Natural Science	Faculty of Natural Science	Number of NUOL teachers will have training in curriculum development and textbook writing	Three batches (18 lecturers) of training/study tour for upgrade the curriculum (in Thailand and Vietnam), 37 lecturers participated in Textbook writing and editing. 39 lecturers participated in seminar on Lesson plan development, Seminar on analysis of heavymetals 13 + student 7+ 8 lecturer write techbooks, Seminar on hydrogeology (20), Lecturers participated in seminar on Lesson plan development (35), Technical meeting for local technician and villagers at Lak 20, bolikhamxay (51), Seminar on Mathematic modeling (20, female 10), Seminar on using plant and animal database (30, female 09), Seminar on Data analysis of water and soil quality (Lecturers 16 (F 7), students 10 (F 8)), Science Conference on Biodiversity and Environment (103, F40), Current knowledge on Montane forest conservation in Lao PDR (64, F9) and others. See attachment sub project beneficiaries
		Revised plan													
		Actual			71 (29)	196 (65)	440 (134)	673 (209)	916 (280)						
Number of students benefitted from upgraded curriculums (cumulative).	#	Plan		0	0	200	400	600	800	Annual	Class Enrollment Records	Faculty of Natural Science	Faculty of Natural Science	Number of students enrolled in courses that have received curriculum upgrades	Number of students in the course that have received curriculum upgrade is 721 students including 370 women. The text books and equipment were also used by other curriculum's students in each department that
		Revised plan													
		Actual													

		Actual		97 (40)	275 (120)	618 (317)	721 (370)	877 (446)				(textbooks + equipment)	share the same subject with the upgrade curriculum.		
Component 2 - Strengthen Capacity in Natural Science Research															
Number of papers / report/ proceeding/ research books on natural science research related to environment protection to be published in domestic and international journals / meetings (cumulative).	#	Plan		0	0	3	8	14	44	Annual	Records of published papers /report/proceeding /research books	Faculty of Natural Science	Faculty of Natural Science	Number of published papers /report/proceeding /research books	Research was conducted from Q4, 2017. Numbers are 3 abstracts in 2nd National Biodiversity conference (2018), 9 proceeding for seminar/ science meeting in Bolikhamxay province (2018), 3 papers in Journals (2019-2020), 3 reports in International Research Forum on Science, technology and Innovation (2019), 12 proceeding in Science conference on biodiversity and environment (2020), 12 proceeding in National Research Forum on Science, Technology and Innovation (2020), 2 proceedings in FNS Scientific conference 2020
		Revised plan													
		Actual		0	0	12	18	44	51						
Number of NUOL FNS students to co-author published scientific journal articles (cumulative).	#	Plan		0	0	6	16	28	56	Annual	Records of published papers /report/proceeding /research books	Faculty of Natural Science	Faculty of Natural Science	Number of graduate students to do research and be co-authors in publication	Research was conducted from Q4, 2017. Students is participated in the research and be co-author for publication. The name of some participate students were put in several proceeding of science conference
		Revised plan													
		Actual		0	0	3	11	56	58						
Number of public participants in NUOL FNS scientific awareness raising activities (Dong Dok Campus & local level villages) (cumulative).	#	Plan		0	0	500	1500	3000	3045	Annual	Meeting records	Faculty of Natural Science	Faculty of Natural Science	Number of participants attended the meeting at FNS and local villages	Awareness rising posters on 9 topics was created and distribute to relavant authorities in bolikhamxay province. The numbers is estimates from PAFO 100, Khamkherd and xaychamphone district 250, DAFO 100, 2 villages 500, Exhibition in ITECC 1000, NUOL festival 200 in 2018. Present at World Environment Day at FES (100), The International Research Forum on Science, Technology and Innovation for Sustainable Development at NUOL (320), posters 9 topics distribute to PAFO, 2 Districts, Khamkert DAFO, 1 villages (370) . In addition, news on technical meeting for dissemination of science research result at Phou Chom Voy to local technical staff and villagers was broadcasted on Bolikhamxay province's TV and posted on TV station's face book website which obtained 4100 view. 105 time person of villagers participated in field survey from 2017
		Revised plan													
		Actual		0	0	2150	2940	3045	3130						
Component 3 - Sub-Project Management															
"Deliverables" proposed in the AWPB completed each year (annual)	%	Plan		-	50%	80%	80%	100%	100	Annual	Annual Reports	Faculty of Natural Science	Faculty of Natural Science	Determined from reviewing tasks in Approved Annual Work Plans	By October 2021, SDA are able to achieve 74 % of the annual target. Completed 6 of total 29 tasks (included FEBM tasks) , 19 tasks are in progress.
		Revised plan													
		Actual			80%	86%	80%	71.00%	74%						
Component 4 - Estimation of Economic Value of Biodiversity Ecosystem Services in Phou ChomVoy Protected Area (Additional fund Joint with FEBM)															
		Plan		0	0	0	0	0	1					Models for Total	

<i>Models for Total Economic Value of Biodiversity Ecosystem Services in Phou ChomVoy Protected Area</i>	#	Revised plan							Annual	Records of published papers /report/proceeding /research books	Faculty of Economic and Business Administration	Faculty of Economic and Business Administration	Economic Value of Biodiversity Ecosystem Services in Phou ChomVoy Protected Area	Completed
		Actual	0	0	0	0	0	1						
<i>Number of papers / report/ proceeding on economic value of biodiversity ecosystem services be published in domestic and international journals / meetings (cumulative).</i>	#	Plan	0	0	0	0	0	3	Annual	Records of published papers /report/proceeding /research books	Faculty of Economic and Business Administration+Faculty of Natural Sciences	Faculty of Economic and Business Administration+ Faculty of Natural Sciences	Number of published papers /report/proceeding /research books	Completed
		Revised plan												
		Actual	0	0	0	0	0	6						
<i>Field guidebooks regarding diversity of ecosystems (floristic characters and vegetations), diversity of flora species, and diversity of fauna in Phou Chomvoy Protected area</i>	#	Plan	0	0	0	0	0	2	Annual	Records of published books	Faculty of Natural Science	Faculty of Natural Science	Records of published books	Completed
		Revised plan												
		Actual	0	0	0	0	0	2						

Note: See attachment sub project direct beneficiaries

Approved by:

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