List of Appendix

Appendix A

1) Institutional Committee list

2) Executive Committee list

1) Institutional Committee list

Acronym	Full Title	Countries	Keyword	Director	Contact
iEES Paris	Institute of Ecology and Environmental Sciences	France, Paris	Environmental sciences, Soil Science, Functional Ecology, Water resources	Dr Christian Valentin (d.a.u.IRD)	Dr Christian Valentin (d.a.u.IRD)
UMR ECO&SOLS	Functional Ecology and Biogeochemistery of Soils and Agrosystems	France Montpellier	Soil Science, Functional Ecology, Biogeochemical cycles in agrosystems	Dr Jean-Luc Chotte (d.u. IRD)	Dr Jean-Luc Chotte (d.u. IRD)
UMR GET	Geosciences Environement Toulouse	France, Toulouse	Environmental sciences, Soil Sciences, geochemical cycles, water resources	Dr. Sylvain Bonvalot (d.a.u.IRD)	Dr Olivier Ribolzi
DALAM	Department of Agricultural Land Management	Lao P.D.R.	Agriculture and forestry research activities	Mr Oloth Sengtaheuanghoung	Mr Oloth Sengtaheuanghoung
NUOL Faculty of Agriculture	The Faculty of Agriculture of the National University of Laos	Lao P.D.R.	Agriculture Science	Prof. Silinthone Sacklokham,	Prof. Silinthone Sacklokham,
LDD	Land Development Department	Thailand	Soil Sciences, Soil biodiversity, agriculture	Mr. Apichat Jongskul (DG)	Mr. Apichat Jongskul
KKU; Faculty of Agriculture	Khon Kaen University	Thailand	Soil Biodiversity, Soil fauna,	Prof. Dr. Monchai Duangjinda	Prof. Dr. Yupa Hanboosong
KU; Faculty of Agriculture	Kasetsart University	Thailand	Ecophysiology, tree plantation, C seq,	Prof. Sornprach Thanisawanyangkura (Vice President of KU)	Prof. Poonpipope Kasemsap
SFRI (VAAS)	Soils and Fertilizers Research Institute. Vietnamese Academy for Agriculture Science	Vietnam, Hanoi	Environmental sciences Soil sciences, impact of fertilizers	Dr. Nguyễn Xuân Lai (DG)	Dr. Tran Minh Tien
ICH (VAST)	Institute of Chemistry of Hanoi Vietnamese Academy for Science and Technology	Vietnam, Hanoi	Water organic matter, soil and water pollution	Prof. Dr. Nguyen Van Tuyen (DG)	Dr. Trinh Anh Duc, Dr Luu Thi Ngueyt Minh

2) Executive Committee list

	Names		Institute	Country	Official title	Field of expertise
Mr.	Oloth	Sengtahevanghoung	DALAM	Lao PRD	Deputy Director, Project leader	Soil physics
Ms.	Silinthone	Sacklokham	NUOL	Lao PRD	Vice Dean of faculty of agriculture	Social Science
Mr.	Alain	Pierret	IRD	Lao PRD	Researcher, LMI LUSES, Dalam	Roots, C seq
Mr.	Christian	Hartmann	IRD	Lao PRD	Researcher, LMI LUSES, Dalam, Project leader	Soil physics
Mrs.	Yupa	Hanboonsong	KKU	Thailand	Professsor, Project Leader	Entomologist
Mrs.	Nopmanee	Suvannang	LDD	Thailand	Co-Director of the LMI LUSES	Soil chemist
Mr.	Alain	Brauman	IRD	Thailand	Co-Director of the LMI LUSES, LDD	Soil Ecology
Mr.	Poonpipope	Kasemsap	KU	Thailand	Director of DORAS Inst.	Ecophysiologist
Mr.	Didier	Lesueur	CIRAD	Thailand	Researcher, LMI LUSES, LDD	Soil Microbiologist
Mr.	Trinh	Anh Duc	ICH	Vietnam	Researcher, Coordinator of JEAI-BioGEAQ	Soil & water chemistery
Ms.	Toan	Tran Duc	SFRI	Vietnam	Head Departement Soil Environment, BioGEAQ	Soil Scientist
Mr.	Christian	Valentin	IRD	France	Deputy Director of UMR IESS head of PPR SELTAR	Soil physics
Mr.	Olivier	Ribolzi	IRD	France	LMI CEFIRSE representative, UMR GET, Project leader	Biogeochemistry
Mr.	Jean-Luc	Chotte	IRD	France	Director of UMR ECO&SOLS	Soil Ecology

Appendix B: LMI list of publication

1. Papers in peer review journals

1. Tran T.N.T., Truong L.S.H., Orange D. and Picquart C., (2014). *Assessment of the environmental risk of glyphosate herbicide and its metabolite AMPA in the canals, surface water at Saigon - Dong Nai and Mekong Delta*. In: Hydrology in a Changing World: Environmental and Human Dimensions, IAHS Publ. 363, under press

2. Janeau J-L., Gillard L-C., Grellier S., Jouquet P., Le Thi Phuong Q., Luu Thi Nguyet M., Ngo Quoc A., Orange D., Pham Dinh R., Tran Duc T., Tran Sy H., Trinh Anh D., Valentin C. and Rochelle-Newall E., (2014). *Export of high loads of soil DOC from small upland, farmed catchments in tropical watersheds*. Agr. Wat. Manag., 146 : 314-323

3. Satakhun D., Gay F., Chairungsee A., Kasemsap P., Chantuma P., Thanisawanyangkura S., Thaler P. and Epron D., (2013). *Soil CO2 efflux and soil carbon balance of a tropical rubber plantation*. Ecological Research

4. Sopharat J., Gay F., Thaler P., Sdoodee S., Isarangkool Na Ayutthaya S., Tanavud C., Hammecker C. and Do F. C., (2014), September 29.*A simple framework to analyze water constraints on seasonal transpiration in rubber tree (Hevea brasiliensis) plantations*. Frontiers in Plant Science, section Crop Science and Horticulture

5. Clermont-Dauphin C., Suvannang N., Hammecker C., Cheylan V., Pongwichian P. and Do F.C., (2013). *Unexpected absence of control of rubber tree growth by soil water shortage in dry subhumid climate*. Agronomy and Sustainable Development. 33(3): 531-538

6. Junjittakarn J., Limpinuntana V., Pannengpetch K., Isarangkool Na Ayutthaya S, Rocheteau A., Cochard H. and Do F.C., (2012). *Short term effects of latex tapping on micro-changes of trunk girth in Hevea brasiliensis*. Australian Journal of Crop Science 6(1): 65-72.

7. Boithias L., Do F.C., Isarangkool Na Ayutthaya S., Junjittakarn J., Siltecho S. and Hammecker C., (2012). *Transpiration, growth and latex production of a Hevea brasiliensis stand facing drought: the use of WaNuLCAS model as an exploratory tool*. Experimental Agriculture 48: 49-63.

8. Siltecho S., Hammecker C., Sriboonlue V., Clermont-Dauphin C., Trelo-ges, V., Antonino, A. and Angulo-Jaramillo R. . 2014. *Use of field and laboratory methods for estimating unsaturated hydraulic properties under different land-use*. Hydrology and Earth System Sciences. Discussions, volume :11,Issues: 6, Pages: 6099-6137.

9. Hammecker C., Maeght J.-L., Grunberger O., Siltacho S., Srisruk K., Noble A. (2012) *Quantification and modelling of water flow in rain-fed paddy fields in NE Thailand : evidence of soil salinization under submerged conditions by artesian groundwater*. Journal of Hydrology, 2012, 456, p. 68-78.

10. Chairungsee N., Gay F., Thaler P., Kasemsap P., Thanisawanyangura P., Chantuma A., Jourdan C. (2013) *Impact of tapping and soil water status on fine root dynamics in a rubber tree plantation in Thailand.* Frontiers in Plant Science,2013,583,p.1-11.

2. Papers in non peer review journals

1. Kunjet S., Thaler P., Gay F., Chuntuma P., Sangkhasila S. and Kasemsap P., (2013). *Effects of Drought and Tapping for Latex Production on Water Relations of Hevea brasiliensis Trees.* Kasetsart Journal (Natural Sciences), 47 : 1 – 10

2. Kunjet S., Thaler P., Gay F., Kositsup B., Chuntuma P., SangkhasilaS. and Kasemsap P., (2013). *Diurnal dynamics of stand transpiration andstomatal conductance in Rubber* (Hevea brasilliensis Muell. Arg.). Kasetsart J. (Nat. Sci.) 47: 647 – 662

3. Sopharat J., Sdoodee S., Tanavud C., Gay F. and Thaler P., (2013). *A simple water balance model of rubber tree plantations under different evaporative demand regimes*. Advanced

Materials Research Vol. 844, pp 20-23.

4. Isarangkool Na Ayutthaya S. and Do F.C., (2014). *Rubber trees affected by necrotic Tapping Panel Dryness exhibit poor transpiration regulation under atmospheric drought*. Advanced Material Research 844: 3-6.

5. Seltacho, S., Sriboonlue, V., Suvanang, N., Wiriyakitnateekul W., Hammecker C., (2013). *Quantification and modeling of water flow in sandy soils in Northeast Thailand (2013) . in ADVANCES IN UNSATURATED SOILS*. Edited by Caicedo, B; Murillo, C; Hoyos, L; et al. 1st Pan-American Conference on Unsaturated Soils Location: Los Andes Univ, Cartagena de Indias, COLOMBIA Date: FEB 20-22, 2013 Pages: 573-577 Published: 2013

3. Congress/Seminar

1. Gay F., Bessou C., Bottier C., Brauman A., Chambon B., Chantuma P., Kasemsap P., Lacote R., Liengprayoon S., Nopmanee S., Robain H. and Thaler P., (2013). *Assessing Ecosystem Services in Rubber Plantations: From Flux Measurements to Life-Cycle Assessment Approach. 3rd Rubber Plant Summit*, 13-15 October 2013, Yangoon, Myanmar.

2. Gay F., Saengtharatip S., Lafaye de Micheaux M., Chantuma P., Chayawat C., Chotipan R. , Suvanang N., Brauman A., Brunet D., Robain H., Sebag D. and Thaler P., (2013). *Impact of Rubber Plantations on Soil Organic Carbon: A Case Study in Chachoengsao province (Thailand)*. 1st Asia Pacific Rubber Conference, 4-5 September 2013, Surat Thani, Thailand.

3. Brauman A., Lafaye M., Perawatchara M., Gay F., Chompunut C., Robain H., Choosai C., Junrungreang S., Chantuma P., Trap J. and Nopmanee S. *Impact of rubber plantation on soil macrofauna biodiversity.* 1st Asia Pacific Rubber Conference, 4-5 September 2013, Surat Thani, Thailand

4. Robain H., Lafaye De Micheaux M., Suvannang N., Brunet D., Gay F., Saengtha S., Ninchawee C., Suaysom W., Le Troquer Y., Chotipan., Brauman A. and Chantuma P., (2013). *Soil variability in a chronosequence of rubbertree plantations in Chachoengsao province*, Thailand. 1st Asia Pacific Rubber Conference, 4-5 September 2013, Surat Thani, Thailand.

5. Chambon B., Kongmanee C., Angthong S., Till M., Brauman A., Gay F., Promkhambut A., Nimkingra P., Koonklang N., Robain H., Michels T. and Lacote R., (2014). *Understanding the relationships between farmers' practices and the agro-environmental performances of rubber smallholdings: a case study in Thailand. In: Rubber Plant Summit*, 25-26 March 2014, Phnom-Penh, Cambodge. Oral presentation

6. Till M., Brauman A., Chambon B., Bessou C., Gay F., Promkhambut A., Nimkingra P., Robain H. and Koonklang N., (2014). *Impacts des pratiques culturales sur l'écosystème du sol dans les plantations d'hévéa du Nord-est de la Thaïlande*, Journées d'Etude des Sols.30 june-4 july.2014. Bourget du Lac, France

7. Kyulavski V., Promnok T., Till M., Peerawat M., Alonso P., Villenave C., Suvannang N., Trap J., Nimkingrat P. and Brauman A., (2014). *Impact of agricultural practices on soil biological functioning in Rubber plantations International.*, 28-30 August 2014. Thaksin University, Phatthalung campus, Thailand.

8. Thaler P., Chambon B., Gay F., Lacote R., Bosc PM., Brauman A., Robain H., Kasemsap P., Sajjaphan K., Sdoodee S. and Chantuma P., (2014). *Can family rubber-farms match global challenges?* World Congress on Agroforestry. 10-12 Feb 2014. New Delhi, India

9. Brauman A., Lafaye, Marin, Perawatchara M., Gay F., Chayawat, C., Robain H., Choosai C., Junrungreang S., Chantuma P., Trap J. and Nopmanee S., (2014*) Impact of rubber plantation on soil macrofauna biodiversity*, World Congress on Agroforestry, 10-12 February 2014, New Delhi, India. Oral presentation

10. Peerawat M., Till M., Kyulavsky V., Villenave C., Nimkingrat P., Koonklang N., Trap J. and Brauman A., (2014). *Could soil macrofauna and nematofauna be suitable indicators of the agricultural practices impacts on soil functioning in Rubber plantation?* Workshop on Epidemiology of Plant Parasitic nematode in South East Asia, 16 -17th June 2014, Hanoi, Vietnam. Oral presentation

11. Trap J., Ranoarisoa P., Perrin A., Irshad U., Villenave C., Brauman A. and Plassard C.,(2014) *Do soil bacteria-bacterial nematodes interactions enhance plant P nutrition? Phytate mineralization as a case study*. Workshop on Epidemiology of Plant Parasitic nematode in South East Asia, 16 -17th June 2014, Hanoi, Vietnam *Oral presentation*

12. Promkhambut A., Till M., Brauman A., Robain H., Chambon B. and Koonklang N., (2014).*Agriculture practices of rubber plantation in Northeast Thailand and its challenge for sustainability.* International Conference on Rubber 28-30 August 2014. Thaksin University, Phatthalung campus, Thailand.

13. Promnok T., Peerawat M., Villenave C., Suvannang N., Kyulavski V., Brauman A. and Nimkingrat P., (2014). *The use nematodes as bio-indicator of different agricultural practices impact on soil functioning in Rubber plantation*. International Conference on Rubber 28-30 August 2014. Thaksin University, Phatthalung campus, Thailand.

14. Perawatchara M., Chevalier T., Abadie J., Laure P.A., Trap J., Lafaye De Micheaux M., Gay F., Robain H., Junrungreang S., Nopmanee S. and Brauman A., (2014). *Impact of rubber plantations on the soil microbial community: case study of a rubber trees chronosequence in Chachoengsao province, Thailand* International Conference on Rubber 28-30 August 2014. Thaksin University, Phatthalung campus, Thailand.

15. Brauman A., Perawatchara M, Lafaye De Micheaux M., Nopmanee S., Choosai C., Robain H., Sebag D., Chevallier T., Abadie J., Trap J. and Gay F., (2014) *Does afforestation of arable land with rubber tree improve soil functioning? a case study in a chronosequence of rubber plantation in Thailand.* International Conference on Rubber 28-30 August 2014. Thaksin University, Phatthalung campus, Thailand

16. Kyulavski V., Promnok T., Till M., Peerawat M., Alonso P., Villenave C., Suvannang N., Trap J., Nimkingrat P. and Brauman A., (2014). *Impact of agricultural practices on soil biological functioning*. International Conference on Rubber 28-30 August 2014. Thaksin University, Phatthalung campus, Thailand

17. Peerawat M., et al.,(2014) *Impact of Land Use Change on Soil Microbial Biodiversity, the case of cassava Transition to Rubber in Chachoengsao*.Land Development Department Research Days 25-26 August 2014.

18. Kyulavski V., Promnok T., Till M., Peerawat M., Alonso P., Villenave C., Suvannang N., Trap J., Nimkingrat P. and Brauman A.,(2014). *Why soil biota matters for agriculture? The impact of agricultural practices on soil biological functioning.* Land Development Department Research Days 25-26 August 2014.

19. Brauman, A., Kyulavski V., Promnok T., Till M., Peerawat M., Alonso P., Villenave C., Suvannang N., Trap J. and Nimkingrat P.,(2014). *What are the best suitable indicators of the agricultural practices in Rubber plantation?* HRPP Conference on agronomy. Kasetsard University 8-9 October 2014

20. Perawatchara M., Chevalier T., Abadie J., Laure P.A., Trap J., Lafaye De Micheaux M., Gay F., Robain H., Junrungreang S., Nopmanee S. and Brauman A.,(2014). *Impact of land use changes from casava to rubber on soil biological diversity. HRPP Conference on agronomy*. Kasetsard University 8-9 October 2014

21. Isarangkool Na Ayutthaya S. and Do F.C., (2013). *Rubber trees affected by necrotic Tapping Panel Dryness exhibit poor transpiration regulation under atmospheric drought*. First Asian Pacific Rubber Conference, 5-6th September, Surat Thani, Thailand. (Oral presentation, OA-04, p 49).

22. Isarangkool Na Ayutthaya S., Do F.C., (2012). *Daily natural rubber production does not reflect mild tree water stress. In the 2nd Symposium on Horticulture in Europe (SHE), under the aegis of the International Society of Horticultural Science (ISHS) and Agro-Campus Ouest*, Angers, 1-5 July, France (Poster).

4. Report

1. Till M., (2013) *Impact des plantations d'hévéa sur le fonctionnement de l'ecosystème sol*. Etude mis en place dans la province de Khon Kaen, Thaïlande. Final report of engineering school. INP Purpan Toulouse. 2013

2. Kyulavski V., (2014) *The impact of agricultural practices on soil functional biodiversity: the Rubber tree cultivation case in Thailand*. Final report. Master Bioressources, Parcours Ingénierie Biologique pour l'Environnement (IBE). 2014

3. Thibaut P., (2014) *Analyse de l'impact des pratiques de fertilisation sur les performances et le fonctionnement de plantations villageoises d'hévéas en Thaïlande*. Master 2 Isara, Lyon

4. Lafaye de Micheaux M., (2013) *Impact of tree plantations on the soil ecosystem: Case of rubber plantations in Chachoengsao province, Thailand*. Final report of gap year Internship. AgroParis Tech. 2013. 18p. 2013

Conference or lectures

1. Orange D. and Tran Thi Nhu T., (2014). *POCIS in practice*. Faculty of Chemistry, VNUS-HoChiMinh City, 18 April 2014, 7 Vietnamese participants from North and South Vietnam

Appendix C: Short report of LMI meeting annual meeting 2014

International Joint Laboratory (LMI) LUSES Annual Meeting
Department of Agriculture and land management of Laos
October 13th to 15th 2014
Vientiane, Laos
Reported by Ms. Caroline Savin

The annual meeting of the LMI LUSES dedicated to "the dynamics of land use changes and soil ecosystem services" took place in Vientiane, Laos from October 13th to 15th 2014.

The LMI LUSES focuses on the environmental impact of agriculture on soil in context of agrarian transition in south East Asia and allows the creation of regional scale projects on this issue. The LMI gathers 2 French and 7 Asian institutions that include a large range of scientific disciplines (soil scientists, geophysics, and biochemist, etc. and it allowed the development of laboratories and field platforms and capacity building equipment in 2012, 2013 and 2014. LUSES partners created the SEALNET laboratory network to improve the quality of the soil analysis and invested in trainings conferences and equipments. In 3 years, the LMI LUSES has trained 215 participants and funded 9 projects.

This meeting was the opportunity for LUSES partners from Thailand, France, Laos and Vietnam to reinforce the partnership and the relationships between the several

institutions. The objective was to gather and to establish an update of the several projects lead by LUSES' teams, to make statements one year after the last annual meeting that took place in Vietnam in 2013 and to determine the main priorities for 2015.

The first day started with a presentation of N.Suvannang from the Land development department of Thailand and co director of LUSES and from Alain Brauman, IRD researcher and LMI LUSES co director. They presented the 2 years achievements of the LMI since its creation in 2012 and the main changes that occurred since 2013.

Researchers presented the interactions between LUSES and other projects that are taking place in south east Asia such as the interactions between the LMI LUSES and IRD through the MSEC observatories, the PPR Seltar, and the RIM PAMAP project; the connections between LUSES and the CIRAD through the Cansea network in agro ecology and the link between LUSES and the SURUMER sustainable rubber cultivation in the making region led by the Hohenheim university.

The day followed up with the presentations of LMI current scientific projects such as the Organic Matter Management (OMM), the TREE PLANTATION project, and ECOFILTER project.

The second day of the annual meeting was dedicated to the project recently funded and related to LUSES : JEAI eco rubber, vertical drainage, hevea adapt, growth and hydraulic traits in rubber clones, towards an improvement of soil and water quality in the context of climate change in Thailand, NUCOWS nutrient cycles and contaminants in water in southern Asia.

The participants then discussed the potential projects trainings for 2015. They mentioned the common project LMI CEFIRSE-LMI LUSES on vermicompost biodiversity and a collective training on how to monitor soil macro fauna biodiversity and activities.

Appendix D: Report of the Executive committee meeting of LMI LUSES 2014

International Joint Laboratory

(Laboratoire Mixte Interntional – LMI)

Land Use changes and Soil Ecosystem Services

Report of the Executive committee meeting of LMI LUSES

Vientiane, Lao PDR

NAFRI-DALAM Campus, 15th October 2014

By the LMI directors

Nopmanee Suvannang & Alain Brauman

Topic of the agenda of the steering committee

1-Presentation by the two LMI LUSES directors
Evolution of LUSES dispositive in terms of:
Scientific organization
Governance evolution
Budget repartition (internal call)

2- Report of 2014 main events

- Scientific projects
- SEALNET project
- Collective trainings

3- Main output of the annual meeting 2014

- Project's appropriation
- Asset and weakness
- main priorities for 2015

3- Budget

- Presentation of 2014's budget
- Approval of 2014's budget
- Presentation of 2015 's budget
- Approval of 2015's budget

4- **Miscellaneous**

1] Evolution of LUSES dispositive

1-1] Governance

Executive committee composition

One of the main output of the Steering committee of 2013 held in Hanoi was the change of the governance of LUSES. The scientific committee was replaced by an executive committee (EC) with the following composition

Names			Institute	Country	Official title	Field of expertise
Ms.	Silinthone	Sacklokham	NUOL	Lao PDR	Vice Dear of the Faculty of Agriculture	Social Science
Mr.	Oloth	Sengtahevanghoung	DALAM	Lao PDR	Deputy Director, Project leader	Soil physics
Mr.	Christian	Hartmann	IRD	Lao PDR	Researcher, LMI LUSES, Dalam, Project leader	Soil physics
Mr.	Alain	Pierret	IRD	Lao PDR	Researcher, LMI LUSES, Dalam	Roots, C seq
Mrs.	Yupa	Hanboonsong	KKU	Thailand	Professsor, Project Leader	Entomologist
Mrs.	Nopmanee	Suvannang	LDD	Thailand	Co-Director of the LMI LUSES	Soil chemist
Mr.	Alain	Brauman	IRD	Thailand	Co-Director of the LMI LUSES, LDD	Soil Ecology
Mr.	Poonpipope	Kasemsap	KU	Thailand	Director of DORAS Inst.	Ecophysiologist
Mr.	Didier	Lesueur	CIRAD	Thailand	Researcher, LMI LUSES, LDD	Soil Microbiologist
Mr.	Trinh	Anh Duc	ICH	Vietnam	Researcher, Coordinator of JEAI-BioGEAQ	Soil & water chemistery
Ms.	Toan	Tran Duc	SFRI	Vietnam	Head Departement Soil Environment, BioGEAQ	Soil Scientist
Mr.	Christian	Valentin	IRD	France	Deputy Director of UMR IESS head of PPR SELTAR	Soil physics
Mr.	Olivier	Ribolzi	IRD	France	LMI CEFIRSE representative, UMR GET, Project leader	Biogeochemistry
Mr.	Jean-Luc	Chotte	IRD	France	Director of UMR ECO&SOLS	Soil Ecology

- Include the heads of the Asian institutions, the heads of the 3 French UMR (ECO&SOLS; GET; IESS), and IRD representatives in LaoPDR, Thailand, Vietnam.

The invited directors and heads in 2014 were:

- Mr. Apichat Jongskul, DG of LDD,
- Dr. Jacques Berger, IRD representative in Thailand
- Dr. Michel Grimaldi (IRD), coordinator of the Biophys team of the UMR IESS
- Dr. Henri Robain (IRD), coordinator of the 'LDD-IRD' TICA project (2013-1016) ,
- Dr. Philippe Thaler (CIRAD), coordinator of the HRPP

The EC will meet on an annual basis while the Steering committee composed with of one representative of each institutions will meet 3 times (beginning-mid term and end of the project).
For this year, Prof. Yupa Hanboosong from KKU was represented by Dr. Kiriya Sungthongwises, leader of the JEAI team ECO-RUBBER and Prof. Poonpipope Kasemsap from KU was represented by Dr. Jessada Phattaralerphong.
The directors suggested to keep a similar governance organization in 2015.

Perspectives for 2015

The EC agree with the current composition of the EC and to keep this organization in 2015

1-2] Scientific Organization

Description

The two directors suggested to keep the current organization in 3 projects and to maintain their respective leaders:

- Organic matter management: Christian Hartmann (IRD) & T. Tran Duc (SFRI)
- ECOFILTER: O.Ribolzi (IRD) & O. Sengtaheuanghoung (Dalam)
- Tree Plantation : A. Brauman & Y. Hanboonsong (KKU)

In 2014 each project followed LUSES guidelines:

- be regional,
- involve Asian students,
- be co-funded,
- organise collective and individual trainings.

Perspectives for 2015

The EC agreed to keep the same scientific organization in 2015.

Responsible

Each project leader.

2) LUSES Budget

2-1] Report of 2014 budget execution

Description

2014	IRD	Co-funding	Total	% Cofund.	Origin of co-fundings
Administration					
Admin	4 636 €	3 000 €	7 617 €	39%	TICA Thailand
Animation	2 226 €	8 199 €	10 425 €	79%	TICA Thailand
Annual meeting	6 500 €	8 356 €	14 856 €	56%	IESS-ECO&SOLS-SELTAR-IFC-CIRAD
Capacity building					
OMM	8 743 €	3 000 €	11 743 €	26%	CEFIRSE, LDD, Royal Project
ECOFILTER	8 884 €	20 000 €	28 884 €	69%	ANR TECITEASY, MSEC, IESS, GET,
TREE PLANTATION	8 743 €	40 698 €	49 441 €	82%	IFC, CRCC, YARA, HRPP, TICA LDD, TICA KU, Cansea, ECO&SOLS
SELNET Network	1 650 €		1 650 €		
LUSES coll. Training	2 500 €	13 000 €	15 500 €	84%	
Total	**43 882 €**	**112 517 €**	**156 399 €**	72%	
% co-funding	**28%**	**72%**			

Perspectives for 2015

No specific comment of the EC on the budget, the EC noticed that about 70% of this budget was devoted to research actions, a ratio that is in line with the demand of the Steering committee in 2013. A more detailed budget is currently under process and will be provided when all the last information from IRD budget officers will be obtained.

2-2] Proposition for LMI 2015 budget

Description

The LMI co-directors presented a budget based on expected IRD contribution (45.000 €, which is the amount received in 2014) and on the co-funding obtained in 2014 via mainly research projects such as:

-*scientific projects*:

- ECOFILTER: the French ANR TECITEASY for the project,
- Tree plantation: the IFC project, and the ANR HEVEAADAPT
- OM: , LDD region 10 and Royal project, LMI CEFIRSE.

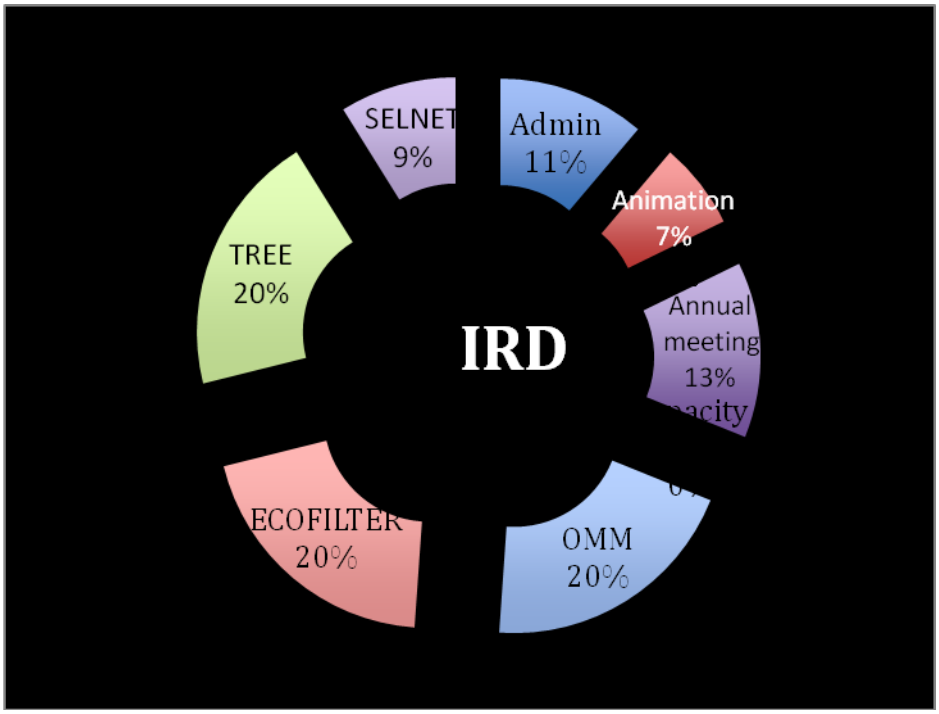
- *administration and animation*: TICA contribution

The budget 2015 (see below) is globally in line with the 2014 one. The only change originated from the increase of the budget of the SEALNET (South-East Asia Laboratory NETwork) project (1 300 € in 2014, 4 000 € in 2015).

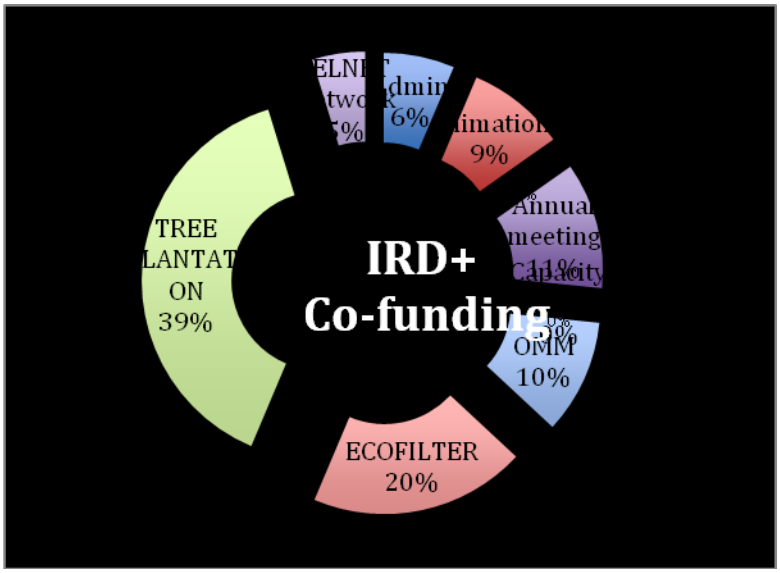
2015	IRD	Co-fundin	Total	% Cofund.
Administration				
Admin	5 040 €	3 000 €	8 040 €	39%
Animation	2 960 €	8 199 €	11 159 €	79%
Annual meeting	6 000 €	8 356 €	14 356 €	56%
Capacity building				
OMM	9 000 €	4 000 €	13 000 €	26%
ECOFILTER	9 000 €	15 500 €	24 500 €	69%
TREE PLANTATION	9 000 €	40 000 €	49 000 €	82%
SELNET Network	4 000 €	2 000 €	6 000 €	
Total	45 000 €	112 517 €	157 517 €	72%

Comments and actions

The EC validated the proposal of 2015 budget, which is in line with the previous budget with a clear priority to research actions. However, due to the uncertainties of the IRD budget and of the future co-fundings, the EC proposed that the budget must be expressed in percentage (see below). Another comment is that co-fundings should be completed by an estimation the human involvement (% ETP) of the partners in the project.



IRD BUDGET 2015 in Percentage



3] Remaining weaknesses

3-1] Involvement of the Vietnamese partners

Description: The current involvement of Vietnam's partners is not in line with the project expectations. This is due to multiple factors but the main one is the lack of students involved in the different LUSES projects.

Perspectives:

1. Increase the involvement in the SEALNET project of ICH and SFRI soil and water laboratories;
2. Develop SFRI participation in the OMM project via the involvement of master students;
3. Fund a preliminary project on Acacia leaded by Didier Lesueur (CIRAD) and Toan from SFRI under the framework of the Tree planation's budget.

3-2] Publications

Comment of the EC

Description: The LUSES project is still young (2.5y) but already accumulates important results within its 3 scientific projects. In 2015, the projects leaders need to increase the level of publication of their respective project.
Perspectives: Each project leader will need to promote the scientific production of its project by organizing collective or individual training on database organization, statistics and writing process. A first step could be the publications of first results in local journal to start the publication process.

Conclusion

The EC was satisfied with the current scientific and governance orientations of the LUSES project in 2014. This project is now well shared by the different partners and despite the inherent complexity of LUSES, it is becoming a recognized scientific actor in the field of soil ecology in the 3 countries involved in this project.

Appendix E: List equipments of LMI-LDD Microbiology Platform

Equipment	Model	Brand	Price	Buyer
96-wells reader	355 Multiksan EX	Lab systems	1,000 €	CIRAD
Laminar flow hood	Faster KBN	Faster	6,000 €	CIRAD
Shaker	Titramax 100	Heidolph	750 €	CIRAD
Thermal cyclers	iCycler Thermal Cycler	Bio Rad	10,000 €	CIRAD
Bunsen burner			50 €	CIRAD Laetita
pH meter	pHS-3D-03J	Sanxin	300 €	CIRAD Laetita
Bunzen burner		VWR	85 €	Didier CIRAD
Bunzen burner		VWR	85 €	Didier CIRAD
Desktop	HP screen	HP		Eco&sols
Desktop	HP computer	HP		Eco&sols
Desktop	HP keyboard	HP		Eco&sols
Desktop	HP mouse	HP		Eco&sols
Gel analyser	Gel doc Universal Hood II	Bio Rad	11,000 €	Eco&sols
Power pack	GPS 200/400	Pharmacia LKB		Eco&sols
UPS	Gold-800	Syndome		Eco&sols
Centrifuge	Biocen22R	Orto Alresa	4,815 €	IRD (Henri Robin)
2 Autoclave	-		2,500 €	LDD
Bench Centrifuge	GMC-260	Lab Tech Dahian Technology	150 €	LDD
DGGE system	Dcode System	Bio Rad	12,500 €	LDD
Electrophoresis tank	GelMate 2000	Toyobo	375 €	LDD
Electrophoresis tank	Wide mini-sub cell gt	Bio Rad	375 €	LDD
Electroporation system	Gene Pulser XCeII	Bio Rad	12,500 €	LDD
Heating block	Thermo E	Bioer Technology	75 €	LDD
Hultra pure water machine	-	-	4,000 €	LDD
PCR hood	Aug PCR02	Lio Lab International	250 €	LDD
Polaroïd	P93DN	Mitsubishi Electric	37,500 €	LDD
Power pack	PowerPac Basis	Bio Rad		LDD
Power pack	PowerPac Basis	Bio Rad		LDD
Printer	Xerox Phaser3121	Xerox		LDD
Thermal cyclers	PCYL220	Thermo Electron Corporation		LDD
UPS	Faith ST10			LDD
UV table	EB-20	Ultra Lum		LDD
Centrifuge	Denville 260D	Denville Scientific		LDD
Water bath	4 Liter Water Bath	Hangzou Bioer Technology	125 €	LDD
Water bath	SP16	Tecam	125 €	LDD

Weighing machine	SI4002	Denver Instrument	750 €	LDD
Bead beater	Fast Prep-24	MP Biomedicales	3,000 €	LMI
Bench Centrifuge	IR	Dutscher	149 €	LMI
Centrifuge	Eppendorf AG (mini spin)	Eppendorf	740 €	LMI
DGGE system	IPU-S	INGENY	7,565 €	LMI
Electrophoresis tank	RunOne Electrophoresis Cell	Embi Tec	470 €	LMI
Magnetic stirrer	RHB2	IKA	200 €	LMI
Peristaltic pump	IPU-P	INGENY		LMI
Pipettes	Multipette plus	Eppendorf	151 €	LMI
Pipettes	Research plus 20-200	Eppendorf	435 €	LMI
Pipettes	Research plus 20-200	Eppendorf		LMI
Pipettes	Research plus 2-20	Eppendorf		LMI
Pipettes	Research plus 2-20	Eppendorf	435 €	LMI
Pipettes	Research plus 100-1000	Eppendorf		LMI
Pipettes	Research plus 100-1000	Eppendorf		LMI
Pipettes	Research plus 0.1-2.5	Eppendorf	195 €	LMI
Pipettes	Research plus 10-100	Eppendorf	195 €	LMI
Pipettes	Research plus 10-100	Eppendorf	195 €	LMI
Pipettes	Research plus 0.1-2.5	Eppendorf	195 €	LMI
Shaker for tubes	R2001	Rotoflex	369 €	LMI
Thermal cyclers	C1000 Thermal Cycler	Bio Rad	5,980 €	LMI
Vortex	VAOTE GENIC 2 6560E	Scientific Industries	179 €	LMI
Vortex	VAOTE GENIC 2 6560E	Scientific Industries	85 €	LMI
INCUBATETOR	MEMERT 720l	Memert	5,600 €	IFC
Micro volume plate	Take3	Biotek		IFC
Septrometer Biotek	EPOCH	Biotek	9,900 €	IFC
Microresp	Microresp starter kit 001	Microresp	500 €	IFC
			141,848 €	

Appendix F

Report of LMI project

1- OMM (Organic Matter Management)

2- ECOFILTER : Effect of land use on stream-ground water interactions

3- Tree plantations

1-OMM (Organic Matter Management)

TITLE

Organic Matter Management [OMM]:
Respective effect of compost and vermi-compost on soil and plant.

LEADER: ASIAN AND FRENCH

- **Vietnam**: Toan Tran Duc (soil scientist): Soils and Fertilisers Research Institute (**SFRI**)
- **Lao PDR**: Christian Hartmann (soil physicist) : Institut de Recherche pour le Développement (IRD), UMR IEES-Paris, LMI LUSES, DALaM (Vientiane)
- **India**: Pascal Jouquet (soil ecologist), Institut de Recherche pour le Développement (IRD), UMR IEES-Paris, LMI CEFIRSE, IISc (Bengalore).

LMI PARTNERS ASIAN (BY ALPHABETICAL ORDER OF COUNTRY) AND FRENCH – IN BOLD CHARACTERS: PARTICIPANTS HAVING COLLECTED DATA IN 2014

India - IISc (Indian Institute of Science, Bangalore)
India - UAS (University of Agricultural Sciences, Bangalore)

Dr. Nagabovanalli Prakash
Dr. Prakasha HC

India – Mount Carmen College (Autonomous)
Dr. Radha Kale
Mrs. Uma Thavamani

Lao PDR - DALAM (Department of Agricultural Land Management)

- Mr. Dr Pheng Sengxua Director of ALUPC (Agricultural Land Use Planning Center)
- Mr. Xaysaith Souliyavongsa, Deputy head of soil and plant laboratory

Lao PDR - NUOL (National University of Lao PDR),

Ms. Phimmasone Sisouvanh (lecturer): soil scientist and agronomist
Mr. Niloud Keomany (assistant lecturer),
Mr. Vankham Solattanavong,
Mr. Deth Sengaloun,
- Mrs. Dr Phoutthasone Sibounnavong (lecturer): microbiologist & biochemist
- Mrs. Pem Louangsackda (lecturer): soil physics

THAILAND – LDD (Land Development Department)

Mrs. **Nopmanee Suvannang** (researcher) Director of the Soil Analysis Technical section)
Ms Thanyakan Sengkhrua (researcher) agronomy
Ms Nantaporn Kobtanyakit (agriculture research officer)
Ms. Dr. Siwaporn Siltacho (researcher) soil physics
Mrs. Dr. Suakanya Taweekij (researcher) nutrient cycling and agronomist

THAILAND – KKU (Khon Kaen University)

Ms. Dr. Kiriya Sungthongwises (lecturer) Nutrient cycling and ecophysiology

VIETNAM - SFRI (Soils and Fertilisers Research Institute)

Toan Tran Duc (soil scientist):
Doan Thu Thuy
Le To Giang

FRANCE:

Mr. Dr. Alain Pierret (IRD UMR 242, LaoPDR), root specialist
Mr. Dr Alain Brauman (IRD, UMR Thailand), soil microbiologist
Mr. Dr Jean Riotte (IRD, UMR) ; soil geochemist
Mr. Jean-Louis Duprey (IRD, Inde, LMI- CEllule Franco Indienne de Recherche en Sciences de l'Eau, **CEFIRSE**)

ASIAN COUNTRIES INVOLVED

Laos	Thailand	Vietnam	Others: India
DALAM, NUOL	LDD region 10 & 5, KKU	SFRI, CHI	ISSc, UAS, Mount Carmen College (LMI CEFIRSE)

SCIENTIFIC PROJECT

Short context

It is currently considered that soil biological activity stimulation resulting from organic matter addition is an efficient way i) to rehabilitate cultivated soils degraded by decades of intensive mining agriculture, ii) to maintain soil productivity in the context of peri-urban agriculture and iii) to recycle urban organic wastes. Indeed, the relations between organic matter addition, biological activity, and ultimately soil characteristics and plant development are complex, because they are multifactorial and encompass a wide range of interaction and feedback processes.

Organic matter is often added to soil under the form of compost (COMP) or vermi-compost (VCOMP). Most agronomical experiments only use one of these two products and rarely compare their respective characteristics and benefits. Few experiments, if any, compared simultaneously the biological, physical and chemical changes induced by COMP or VCOMP addition. Thus, it is still difficult to generalise the results published about organic mater management (OMM) and to finally make relevant recommendations to farmers or environmental managers.

Objectives

Our practical objectives are:

1. to compare the characteristics of COMP and VCOMP when made from similar organic products;
2. to measure the effect of COMP and VCOMP on (i) soil physical, biological and chemical characteristics and thus on (ii) the development of a cultivated plant; the control will be same soil and plant with addition of chemical fertilisers.
3. to put a specific focus on plant response in the case of water stress or water deficiency when VCOMP is used because a significant positive effect of VCOMP was suggested by previous experiments.

In addition to these scientific questions, our objective is also to enhance capacity of participants on some research methodologies and specific techniques that will be implemented during the project.

○ *Methodologies*

Firstly, the same organic matter will be used to prepare COMP on the one hand and VCOMP on the other hand. We hypothesize that their C/N will be different as well as their biological activity: more organisms involved in nutrient cycling (so called 'beneficial' organisms) should be found in VCOMP. The different products will be characterised on physical (% dry mass, particle size…), chemical (C/N, mineral element content, mineral/organic N, etc…) and biological basis (microbial community, fungus community, etc…). In the different countries, we will use the same composting and vermicomposting procedures but different organic source products, providing generalizable information.

Secondly, the effects of COMP and VCOMP on soil and plant characteristics will be tested in mesocosms. Soil **mesocosms** are designed to provide a limited soil volume with close to natural conditions, in which environmental factors can be realistically manipulated. Mesocosms provide a powerful tool to link between *in situ* (but often only correlative) field studies on the one side, and small-scale far from natural laboratory experiments on the other side. Compared to laboratory approaches, mesocosm studies have the advantage (i) to create 'close to natural conditions', and (ii) allow us to select the factors that we want to reproduce and control.
Most of the experiments on VCOMP have neglected the soil physical characteristics and the soil/water/plant relations; consequently we will focus on these original aspects. A main characteristic of *in situ* soil profiles is the **vertical heterogeneity** that has consequences on **water transfer and root system development**. The development of the root system depends on soil physical characteristics and also water and mineral nutrient amount and location. To take these characteristics into account our mesocosm will be a soil column of 60 cm high that **reproduces a loose layer (0-20 cm) on the top of a more compact subsoil (20-40 cm)**; the irrigation (amount and frequency) will be controlled, i.e. irrigation will vary from excess of water (that will allow to collect and analyses leachates) to stressing conditions (to demonstrate benefits from OM addition on plant resistance). The amount of water in the different layers will be monitored during plant development to estimate the water use efficiency for the plants. The test plant will be maize that will be grown until flowering stage. During the plant growth, we will measure basic physiological characteristics (leaf numbers, LAI, root system, biomass…). At the end of the experiment, the effect of compost on soil characteristics and on the plant functioning will be measured: development of the root system, total porosity, pore size distribution, soil biological characteristics (bacteria, fungus, nematodes) and chemical characteristic (pH, CEC, exchangeable cations, etc…).

Thirdly, similar experiments will be conducted in open fields in different countries and regions. Field conditions will involve the presence of more diverse soil fauna an will induce new interactions with rainfall, climate, soil tillage, farmers' management, etc… that can decrease or increase the beneficial effects for soil and plants. Our experiments will provide information on those new interactions that cannot be studied in mesocosms, and will allow economical measurements to assess feasibility and benefits of COMP and VCOMP in the different countries.

○ *Main results*

1. Experiment have been launched in 3 countries and 4 different locations

- **Laos**: at the faculty of Agriculture of NUOL that is located in the city of Nabong, 35 km from the center of Vientiane and 20 km from the campus of Dong Donk and

NAFRI/DALAM. The experiment is leaded by Ms. Phimmasone Sisouvanh (lecturer at NUOL) who will prepare her PhD on this subject (registered at KKU, with LMI & JEAI budget); she is seconded by other lecturers (Mr. Niloud Keomany, Mr. Vankham Solattanavong , Mr. Deth Sengaloun), students and an assistant paid by OMM (Mr. Niloud Keomany)

- **Thailand**: they are two mains locations:
    - Khao Cha-Ngum Royal Study Center for Land Degradation Development that is located near the city of Ratchaburi, 100 km west of Bangkok. The experiment is leaded by Ms. Thanyakan Sengkhrua (researcher from Land Development Department, LDD, Regional Office 10) under the supervision of Mrs. Nopmanee Suvannang (researcher) Director of the Soil Analysis Technical section). Ms. Thanyakan will prepare a master degree on soil Science (Kasetsart university, Kampangsaen campus, Nakorn Pratom province, with LDD and personal budget). She was assisted by local staff from Royal project (in particular Ms Nantaporn Kobtanyakit; agriculture research officer)
    - Khon Kaen, the experiment is leaded by Mrs. Dr Sukanya Taweekij (researcher from Land Development Department, LDD, Regional Office 5) under direct funding from LDD but using the OMM procedures and participating to our network.
- **Vietnam/India**: in Vietnam the experiment is leaded by Doan Thu Thuy. As she already conducted vermicompost experiments in Vietnam, we decided to start strengthening the cooperation with India, and send a Vietnamese student to work with Pascal Jouquet (previously based in Vietnam and who was Thuy's PhD advisor) and our Indian partners from Bangalore (Indian Institute of Science and Factulty of Agriculture). This partnership will also create a link with experiments previously conducted in both countries (in Vietnam by Thuy and Pascal in India by our local partners).

In these different locations, we will use the soil that can be found locally, thus we have different textures and different chemical characteristics:

Location	Texture	pH
Nabong (Lao PDR)	Sandy loam	acidic
Ratchaburi (Thailand)	Sandy	acidic
Khon Kaen (Thailand)	Sandy	saline
Bangalore (India)	Clayey (non swelling)	acidic

2. Earthworm breeding

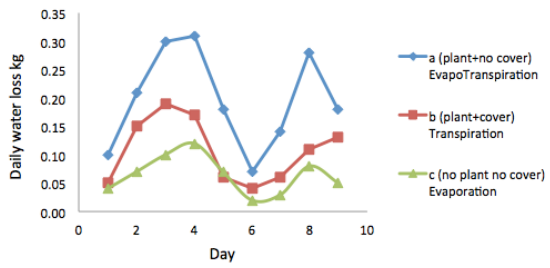
2.1. To produce vermicompost, it is necessary to master the techniques associated with the breeding of earthworms and get some practical skills. We have thus organised training about earthworm breeding for Lao and Thai participants, as they were not as familiar as Vietnamese and Indian participants. The training was organised by Mr. Dr. Somchai who was Professor/lecturer at Kasetsart University and who is now consultant for vermicomposting and who has a company producing and selling VCOMP.

Vermicomposting units have been installed at Ratchaburi and Nabong and will be launched in Khon Kean with similar earthworms species and similar breeding techniques. This synergy between the different institutions, locations and researchers will facilitate the fast development of efficient techniques in this ecological region. In the next months we need to increase the number of individuals to start producing compost and vermi-compost that can be used for column experiments. And at the same time, similar organic waste will be used to produce compost; the exact procedure has to be decided during the the annual meeting.

3. Column and pot experiments

We have decided in common of the technical characteristics of the column, the filling procedure to control the soil physical characteristics (bulk density/porosity, initial water content) and we made preliminary experiments to test the soil structural stability with time, especially during and after irrigation as it is a major factor of instability.

A major characteristic that we need to monitor is the use of water by the plants. We have equipped Nabong and Ratchaburi stations with balance which capacity is 60 kg with a precision of 10 g. We have conducted preliminary experiments to check the accuracy of our weighing technique and the capability to distinguish plant transpiration from direct soil evaporation. These tests were conclusive:



This experiment compared 3 treatments in which we vary the presence of plant and the presence of a plastic soil cover that stops the evaporation. The objective was to distinguish evaporation from transpiration. Each point is the mean of 3 values (errors bars not presented). We observe that a=b+c.

4. Roof cover construction

To benefit from natural light and temperature, we wanted to avoid green houses that need complicate and/or expensive temperature control and thus we installed roof covers with high quality plastic sheets and strong constructions able to resist the wind.

○ *Main output*

Institutions and people involved in this project had more knowledge on surveys than on setting up experiments. Thus the first output was to teach them the importance of selecting a relevant (narrow enough) scientific question they want to answer, and thus deciding which factors need to be controlled and what characteristics need to be measured and monitored, how to set up the control and the treatments, etc…

To do accurate and relevant measures, we had also to show the importance of calibration and standardisation, use of replicates and statistical tests, the need to involve a large team of people (colleagues, students, technicians, etc…) with complementary skills (i.e. team work and network vs individual actions).

We have now a network of people from different countries and different institutions that have the same bedrock of knowledge and the same way of working, making communication on comparison on the results much easier.

Similar earthworm breeding units anre developed in different regions so that experiment can be conducted along a transect of agro-ecological conditions with similar or comparable products.

- ***Valorization (if any)***

Data sets are being acquired in the three countries.

- ***Problems (if any) encountered***

1. to start from ground: getting some basic instruments (balances, etc…) to have the same quality of equipment in all laboratories; to train the different people for different techniques so that every body has the same skills.
2. to set up and manage earthworms breeding at the same time as the column experiment, especially when the participants needed to take leaves for their trainings and other professional and personal commitments.
3. to find time to organise meetings to decide together the procedure and to make decisions on technical and scientific options.

- ***Perspective 2015***

The LMI meeting in Vientiane (October 2014) will be the opportunity to have a meeting with most of the participants to make collective decisions. The perspectives here under are only suggestions that will adapted according to our discussions.

1. *Earthworm breeding:*

During the annual meeting we must decide:

- what organic wastes we will use for our making COMP and VCOMP, how we are going to produce them, what amount we need, how we are going to characterise these products, and on what basis we can compare them to chemical fertiliser.
- how many earthworms we need to produce and what infrastructure we need.

2. *Column experiment.*

Before being able to obtain our own COMP and VCOMP, we will use standard vermicompost produced by Dr Somchai (Thailand) as its quality is controlled and its production is standard making it quite stable with time.

A first full experiment should be finished in January with that standard product. The control situation will be chemical fertilising and the treatments will be two amounts of vermicompost and two irrigation amount. We will be able to conduct all plant characterisations (above and below ground) and all soil physical, biological, and chemical characterisations. A first paper should be drafted before April 2015 (it will perhaps not ready for publication but it will be a practical example for using the trainings about statistics, wrting scientific papers in Englis, etc…).

We will thus be able to run a second columns experiment to compare COM and VCOMP with improved and tuned-up procedures; this second experiment should be finished not later than June 2015. A second paper should be drafted before September 2015, this paper has to be published.

3. *Field experiment.*

According to the results obtained in columns, we will decide a procedure for field experiment. Such an experiment will be launched during the rainy season 2015 with

collaboration of students. The procedure will be decided during a work meeting that should be organised in India

- ***Capacity Buildings***

  - **Equipment's**
    PVC columns equiped to contain soil and plants.
    Precision balances to fill the columns with precise weight and to monitor changes is water content during plant growth.
    Stands to install the columns.

Trainings attended by OMM members:

- Initiation to vermicomposting – (LDD Bangkok, 30 March-1st April 2014)
- Initiation to MicroResp (LDD Bangkok, 2- 4 April 2014)
- Biofertilizer (LDD Bangkok, 20-26 April 2014)
- Using Internet for Bibbiographic Searches (DALAM office by visioconference with IRD Bondy documentation center, 3 sessions of 2 h each)
- Using suction tables and pressure plates to characterise soil ater content (DALAM, 23-24 September organised by private company selling the instruments)

Work meetings for collective preparation of the experiment

- Phimmasone (NUOL) went to Ratchaburi research station (Thailand) 5-9 May 2014
- Thanyakan (LDD) went to NUOL, Nabong campus (Lao PDR), 28-31 August 2°14.

- ***Budget report***

  - LMI

Schematical presentation of OMM 2014 budget (in k€, *i.e.* thousands of euros):

- 1/3 for equipment to improve the capabilities of some laboratories (Nabong, Ratchaburi),
- 1/3 for operating cost, *i.e.* chemical, spare parts, etc (Vietnam/India)
- 1/3 for improving the skills of the people with collective trainings (2 k€) and a specific expense for the registration of Ms. Phimmasone (PhD at KKU, first semester).

Amounts of co-funding were not reported because they are difficult to evaluate.
Note that:

- laboratories to which equipment was provided (Nabong and LDD Reg 10) and have (i) provided 'co-funding' through working time (including researchers for 50 to 90 % of their time) and/or (ii) have covered all operating costs;
- laboratories to which we have covered operating costs (Vietnam/India) have provided all necessary equipment to run the experiment and subsequent analysis;
- note also that LDD has bought some specific equipment (for 1 k€ approximately in region 10) and will cover all its expenses in region 5 with a research budget of 5 k€ and a researcher at 30 % of her time + research assistant, transportation, etc….

  - Comments (if any)

2] ECOFILTER : Effect of land use on stream-ground water interactions

TITLE

Effect of land use on stream-ground water interactions, overland flow genesis and the related ecosystem services of the critical zone in tropical agro-ecosystems [**ECOFILTER**]

LEADER: ASIAN AND FRENCH

- Oloth Sengtaheuanghoung, Laos, Department of Agricultural Land Management (DALaM) - Agricultural Land Use Planning Centre (ALUPC) - Ministry of Agriculture and Forestry (MAF)
- Olivier Ribolzi, France, Institut de Recherche pour le Développement (IRD) - Géosciences Environnement Toulouse (GET)

LMI PARTNERS ASIAN AND FRENCH

- **LAOS**:
  - Oloth Sengtaheuanggoung (DALaM)
  - Pem Louangsackda (National University of Laos, NUoL)
  - Phimmasone Sisouvanh (National University of Laos, NUoL)
  - Chanthanousone Thammahacksa
  - Keoudone Latchachack
  - Phapvillay Sounyaphong
  - Soulileuth Bounsamai (IRD)

- **THAILAND**
  - Two officers will be designated by the direction of LDD (Land Development Department, LDD) to implement the EcoFilter experiment at Huay Lang catchment which will be equipped early 2015

- **VIETNAM**
  - Rinh Pham Dinh (Soils and Fertilisers Research Institute**,** SFRI)
  - Hai Tran Sy (Soils and Fertilisers Research Institute**,** SFRI)
  - Tran Duc Toan (Soils and Fertilisers Research Institute**,** SFRI)

- **FRANCE:**
  - **<u>iESS-Paris (UMR 242)</u>**
    - Alain Pierret (IRD, Laos)
    - Norbert Silvera (IRD, Laos)
    - Jean-Louis Janeau (IRD, Vietnam)
    - Henri Robain (IRD, Thailand)
    - Yann le Troquer (IRD, Thailand)
    - Anneke de Rouw (IRD, France)
    - Christian Valentin (IRD, France)

- Emma Rochelle-Newall (IRD, France)

- **<u>UMR GET (UMR5563)</u>:**
  - Frédéric Guerin (IRD, Toulouse);
  - Olivier Ribolzi (IRD, Toulouse),
  - Stéphane Audry (CNAP, Toulouse);
  - Jean Riotte (IRD, Inde, LMI- CEllule Franco Indienne de Recherche en Sciences de l'Eau, CEFIRSE)
  - Jean-Louis Duprey (IRD, Inde, LMI- CEllule Franco Indienne de Recherche en Sciences de l'Eau, CEFIRSE)

OTHERS PARTNERS

- **THAILAND**:
  - Arthorn Boosaner Wildlife and Plant Conservation Department (**DNP**)
  - Settha Khossukh Wildlife and Plant Conservation Department (**DNP**) and field staff
  - Nikom Hmaimum
  - Navarat Kamanee

- **INDE**:
  - Sumithra K.N (CEFIRSE)
  - Praveen Reddy (CEFIRSE)

ASIAN COUNTRIES INVOLVED

Thailand	Vietnam	Laos	Others: India
LDD, DNP	SFRI	DALaM, NUoL	CEFIRSE

SCIENTIFIC PROJECT

Short context

The long-term sustainability of tropical agro-ecosystems is at risk. This is due to a combination of biophysical factors (e.g. intense rainfall events or climate change), and of human-induced constraints such as rapid land-use change. In this context, a prerequisite to maintain functional biodiversity and associated ecosystem services of these production systems is to design and implement innovative agricultural practices that limit soil and fertility losses by overland flow, stream water contaminations and favour rainfall infiltration and storage in the soil ("green water").

Objective(s)

The objective of the project is to provide new scientific knowledge on the filtration of overland flow ("grey water") by soil and vegetation along hillslopes and in the riparian zone in tropical agro-ecosystems.

The research will cover three converging scientific actions: **(1)** comparative study of the hydrological behaviour of studied catchments (i.e. overland flow genesis, groundwater inflows…) during storm and inter-storm periods; **(2)** estimation of the export of carbon in dissolved, particulate and gaseous forms at the outlet of the catchments, and quantification of the amounts trapped in the riparian zone depending on the vegetation cover types; **(3)** Study the dissemination during floods of free and particle-bound faecal contaminants (i.e. *E. coli)*.

In addition to these scientific questions, it is our objective to enhance capacity building through the training of colleagues from Thailand, Laos, Vietnam and India on the research methodologies implemented during the project and their interpretation (i.e. water quality measurements, geophysical-based and tracer-based approaches).

Methodologies

The methodological approach is twofold: (1) surface flow measurements using micro-plots and Gerlach trough, (2) overland flow quantification at the catchment scale using a tracer-based approach for the separation of storm hydrographs, and (3) inter-stormflow measurements along the stream and quantification of stream/groundwater interactions (inflows, outlflows, ...) using artificial tracers and geophysical survey.

We have used the logistics for the experiments in the TECITEASY project in Laos (ANR Agrobiosphère). Partners from Thailand, Vietnam and India will join the experiments in 2014 and 2015 and learn the appropriate techniques on this occasion. Back in their own country, they will then reproduce specific parts of the experiments in their own measurement site.

Spatial scales considered: the levels of organization of the "critical zone" (National Research Council, 2001), that will be investigated are (1) plot scale (1-m^2) where we will investigate inter-rill mobilisation by « splash » and overland flow under different land uses and (2) medium size catchment scale (1-10 km^2) where we will investigate the stream variations during low flow and stormflow.

Time scales considered: several time scales will be considered to identify the response variability of bacterial communities to global change: (1) hourly to understand short term processes during rainfall-runoff event and (2) monthly to identify seasonal variations.

Genericity of the project: We will work on typical rural watersheds of South East (MSEC observatory) and South (BVET observatories) Asia, part of the network of observation and experimentation facilities for environmental research, SOERE RBV (http://rnbv.ipgp.fr/). These watersheds cover a wide range of situations in terms of morpho-pedology, land use, and human density.

Main results

At the plot scale: Estimate of runoff coefficients, soil detachment rates and electrical conductivity (EC) in overland flow. These observations were conducted under different land uses and are being processed for the catchments in Laos, Thailande and Vietnam. Because the rainfall season is not finished, data are not yet available.

At the hillslope scale: An experiment to assess the permeability of the soil for different land uses, and the ability of the natural riparian vegetation to trap

sediment is underway. The analysis of the first results is encouraging and suggests the possibility of proposing an alternative management of teak plantations in Laos to preserve ecosystem services.

At the catchment scale: The monitoring of EC both in overland flow (sampled at the plot scale) and stream waters (PONSEL sensors installed at the outlets of catchments in 2014) is ongoing. Estimate of Hortonian overland flow using EC-based separations of storm hydrographs will be soon implemented in the different countries after the rainy season.

MAIN OUTPUT

The main outcomes are both on scientific aspects (i.e. a comparative study between Asian sites) and capacity building. Guidelines for the management and integrated development of the landscape so as to: (1) limit losses of soil and carbon along agricultural hillslopes (choice of crops and practices, and functionally optimized landscape mosaics); and (2) conserve the filtering functions of riparian zones (e.g. trapping of sediment and faecal bacteria) to mitigate contamination of pond and streamwater ("blue water") and production systems, particularly during stormflow will also be produced.

VALORISATION

Data sets are being acquired in the three countries

PROBLEMS ENCOUNTERED

Due to budget limitation, it was unfortunately not possible to extend the project to India (collaboration with CEFIRSE and BVET observatory) as expected. The comparison with South East Asian sites should nevertheless be made on the hydrological aspects at the catchment scale (i.e. EC-based hydrographs separation of stream flow in the Madhur cathment)

PERSPECTIVE 2015

At the plot scale: We plan to continue the observations using micro-plots in the three countries. Depending on the available funds, new plots will be deployed in the newly instrumented site by the LDD in northern Thailand (Huay Lang catchment). The latter has the advantage of being covered by rubber plantations and thus complement the existing observation sites of MSEC.

At the hillslope scale: We plan to maintain the observation setup in Laos depending on the results obtained during the 2014 rainy season.

At the catchment scale: We plan to continue the observations using PONSEL sensors in the three countries. A bi-monthly sampling of the main weirs and monitoring of the stream water quality will be conducted in order to understand better the seasonal variability of processes. Depending on the available funds, new plots will be deployed in the newly instrumented site by the LDD in northern Thailand. In addition to monitoring the flow of fecal indicator bacteria, we plan to extend the observations to carbon fluxes. Finally, to understand the interaction surface to subsurface flows at the base and to specify the nature of ecosystem services, a measurement along different streams will be carried out in the three countries.

CAPACITY BUILDINGS

Students involved (master, PhD etc.)

- Kampaseuth XAYATHIP (on going) - Conversion of a shifting cultivation system with fallow into perennial plantations (Tectona grandis, L.) in a montane agro-ecosystem of Northern Lao PDR: effect on surface and subsurface hydraulic conductivity of soils. University of Laos, Faculty of Agriculture (Master degree) co-directed by Christian Hartman and Olivier Ribolzi.
- Siviengkhone Dimak (on going) – Sediment trapping efficiency of cultivated and natural vegetation on sloping riparian areas of Northern Lao PDR. University of Laos (Bachelor of Science, BSc) co-directed by Phapvilay Sounyaphong and Alain Pierret.
- Suksayarm Phanomsouk (on going) – Effect of cropping system type (i.e. slash and burn system and teak plantation) on overland flow generation and soil erosion in a tropical montane catchment of Lao PDR. University of Laos (Bachelor of Science, BSc) co-directed by Keo Oudone Latsachack and Norbert Silvera.
- Jintara Keomanysone (on going) – Runoff generation and soil detachment under various soil covers representative in a northern Lao PDR agricultural catchment. University of Laos (Bachelor of Science, BSc) co-directed by Bounsamay Soulileuth and Christian Valentin.

TRAINING

Description

On-the-job training ECOFILTER (16 to 20 June 2014)

Objective

Provide new scientific knowledge on the filtration of overland flow ("grey water") by soil and the vegetation along hill slopes and the riparian zone in tropical agro-ecosystems

Train national colleagues from Thailand, Laos and Vietnam on the research methodologies implemented during the project and their interpretation (i.e. water flows and water quality measurements)

List of Participants

	First Name	Last Name	Country	Institute
Trainees				
Mrs	Pem	LUANGSAKDA	Lao PDR	NUoL
Mr	Oloth	SENGTAHEUANGHOUNG	Lao PDR	DALaM
Mr	Nikom	HMAIMUM	Thailande	DNP
Mrs	Navarat	KAMANEE	Thailande	DNP
Mr	Hai	TRAN SY	Vietnam	SFRI
Mr	Rinh	PHAM DINH	Vietnam	SFRI
Assistants in Lak Sip				
Mr.	Keooudone	LATSACHACK	Lao PDR	IRD-Vientiane
Mr.	Bounsamay	SOULILEUTH	Lao PDR	IRD-Vientiane
Mr.	Phabvilay	SOUNYAFONG	Lao PDR	IRD-Vientiane
Mr.	Chanthanousone	TAMMAHAKSA	Lao PDR	IRD-Vientiane
Trainers				
Mr.	Olivier	RIBOLZI	France	IRD-Toulouse
Mr.	Norbert	SILVERA	France	IRD-Vientiane
Mrs	Emma	ROCHELLE NEWALL	France	IRD-Paris
Mr.	Henri	ROBAIN	France	IRD-Bangkok
Mr.	Alain	PIERRET	France	IRD-Vientiane
Mr.	Corentin	CLEMENT	France	IRD-Vientiane
Mr	Christian	VALENTIN	France	IRD-Paris

MAIN OUTPUT

Capacity building of trainees during three main working sessions that included field/laboratory measurements and their interpretation: (1) Workshop « runoff versus infiltration at plot scale along hill slope » (Field work, 1m2 plots and Gerlach plots runoff measurements and surface description, office work Calculations and interpretations); (2) Workshop « Water quality » (Field and Lab work Physico-chemical measurements and E coli analysis, Lab work Alcalinity measurement by GRAN titration; Calculations and interpretations); (3) Workshop « run-off versus infiltration at sub-catchment scale » (Field work Discharge measurements, Pumping tests, Office work Hydrogram separation methods, Calculations and interpretations).

PERSPECTIVE

Next year, on the job training will be organized in order to continue the second main component of the project: i.e. the analysis of interactions between groundwater and stream at base flow. As in 2014, this course will rely on logistical support from ANR TECITEASY project in Laos. Within the limits of available funding, we will focus on flow dynamics analysis of carbon in addition to microbial contamination.

Among the capacity building objectives, we will also organise a transfer of know-how on monitoring watersheds from RBV-Asia network to the LDD team in the Northern provinces of Thailand. Exchange of expertise in various fields such as chemical analysis of water (CEFIRSE, India), the analysis of soils (LDD, Thailand), analysis of fecal contaminants and measurement of water flow and sediment (IRD, Laos).

EQUIPMENT

Short description and purpose

Turbidimeters (*in situ* measurement of turbidity value) and UV lamp (used for microplates reading)

BUDGET REPORT

LMI

Situation au 15/05/2014		
On-job training (June 2014)	3,185.02	36
Consumable for laboratory and small equipments	5,742.87	64
Total	8,927.89	

Notification RIBOLZI Olivier EOTP LUSES - Dépenses de fonctionnement

Enveloppe	Implantation	N° Cde	Fournisseur	Engagé (€)	Liquidé (€)	Reste sur engagé (€)
HC210F-1R210-NV00-LUSES	IRD Montpellier	10153960	Fisher Scientifique	3,191.54	0.00	3,191.54
		10153966	BIOKAR	1,792.35	0.00	1,792.35
	IRD Hanoi		Billet HAN-PLQ AR TRAN SY HAI	233.73	0.00	233.73
			Billet HAN-PLQ AR PHAM DINH RINH	233.73	0.00	233.73
			Taxi	58.80	0.00	58.80
	IRD Vientiane		Billet VTE-LPQ AR PEM LUANGSAKDA	126.42	0.00	126.42
			Billet VTE-LPQ AR OLOTH SENGTAHEUANGHOUNG	126.42	0.00	126.42
			Taxi	30.87	0.00	30.87
	IRD Bangkok		Billet CNX-LPQ AR NIKOM HMAIMUM	228.95	0.00	228.95
			Billet CNX-LPQ AR NAVARAT KAMANEE	228.95	0.00	228.95
			Billet BKK-CNX-LPQ-BKK HENRI ROBAIN	322.35	0.00	322.35
			Frais Luang Prabang (justificatifs caisse d'avance)	1,534.79	0.00	1,534.79
			Bus Phrae-CNX (estimation)	60.00	0.00	60.00
			Peristaltic pumps (chemical gauging Thai and Viet)	758.98	0.00	758.98
Résultat				**8,927.89**	**0.00**	**8,927.89**

Montant Notifié	**9,000.00**
Montant Disponible	**72.11**
% consommé	**99.20%**

About two-thirds of the budget was used for the acquisition of consumables for laboratory (e.g. microplates for *E coli* analysis etc.) and small equipment (turbidimeters, UV lamp etc.) needed for water quality measurements in Vietnam and Thailand.

The remaining third of the budget was dedicated to the "on-the-job" training in June 2014 at Luang Prabang, Laos.

Others funds

About 20 k Euros as follow:

- IRD own budget (Olivier Ribolzi), contribution to Ribolzi O. regional tour in October 2014 (1000€)
- MSEC budget, contribution to Chantanousone T. (IRD-Laos field assistant, water quality) and Latchachack K. (IRD-Laos field assistant, hydrology), regional tour in October 2014 (3000€)
- ANR TECITEASY, scholarships (7 months) three Lao students (6000€)
- ANR TECITEASY, microbial analysis in Laos (2000€)
- ANR TECITEASY, construction/installation of Gerlach trough and microplots in Laos (2000€)
- ACI IRD (Christian Valentin), construction/installation/monitoring of microplots in Thailand and Vietnam (5000€)
- IRD own budget (Jean-Louis Janeau) Incubator for Vietnam (1170€)

COMMENTS (IF ANY)

The percentage of quo-financing was unusually high this year. The level of this contribution will probably decline next year and the continuation of the project is therefore conditional on the renewal in 2015 of the LMI contribution, at least at a level equivalent to the 2014 level.

3- Tree plantations

TITLE

Impact of tree plantation on soil function and soil biodiversity

LEADER: ASIAN AND FRENCH

- Pr. Yupa Hanboonsong (KKU), Vice professor of Entomology, faculty of Agriculture of Khon Kaen.
- Mr. Alain Brauman, Institut de Recherche pour le Développement (**IRD**) – UMR ECO&SOLS, Land Dept Development. Bangkok. Thailand

PARTNERS ASIAN AND FRENCH

ASIAN

- LAOS:
  Pr. Silinthone Sacklokham (NuOL), Avakat Phasouysaingam (NUOL Lecturer, PhD student)

- THAILAND:
  KKU: Arunee Promkhambut (social sciences) Prakaijan Nimkingrat (nematodes), Chutinan Choosai (Soil fauna), Kiriya Sungthongwises (soil nutrient cycle), Supat Isarangkool (Tree physiologist)

  LDD: Supaporn Junrungreang (soil microbiology), Nopmanee Suvannang (soil chemist); Phantip Panglang (Tree physiologist); Siwaporn Siltacho (Soil Scientist)

  KU: Pimpak Heepngoen (PhD student), Kanika Sajaphan (Assoc. Pr. Microbiologist)

  RRITT: Pissamai Chantuma

- VIETNAM:
  Tran Duc Toan (Soils and Fertilisers Research Institute, SFRI)

FRANCE:

- iESS-Paris (UMR 242) : Alain Pierret (IRD), Christian Hartmann (IRD), Henri Robain (IRD)
  Jerome Mathieu (UPMC, France)
- UMR ECO&SOLS (UMR210): Jean Trap (IRD, Montpellier), Tiphaine Chevalier (IRD, Montpellier), Fred Gay (CIRAD, Montpellier); Didier Lesueur CIRAD, Thailande), Philippe Thaler (CIRAD, Thailande), Pascal Alonso (VI, IRD, Thailand)

OTHERS PARTNERS

- France: Bénédicte Chambon (CIRAD, UR 34 Thailand), Cecile Bessou (CIRAD, UR 34 France), Thibaud Daecans (CEFE, Montpellier)

ASIAN COUNTRIES INVOLVED

Thailand	Vietnam	Laos
LDD, KU,KKU, PSU	SFRI	NUoL

SCIENTIFIC PROJECT

Short context

South East Asia concentrate produced more than 92 % of the world production of natural rubber. In the last decades rubber plantations replaced many farming systems as traditional subsistence agriculture or commercial crops, but also encroached into and replaced large areas of natural forests, especially in the Greater Mekong Subregion (GMS). Despite the economic and ecological importance of Rubber, studies on the influence of rubber trees plantations on the environment and more specifically on the main soil ecosystem services remains scarce

Objective(s)

These proposals have a scientific and a methodological objective

1- SCIENTIFIC OBJECTIVE

General: To characterize the impact of rubber tree plantation in Thailand and Lao on soil biodiversity and related soil ecosystems services such as nutrient cycling and C sequestration

Specific in 2014: To characterize and assess the impact of agriculture practices on soil functional biodiversity, C sequestration and nutrient cycling)

2- Methodological Objective

Why a methodological objective? The scientific objective involves the comparison of a wide range of agro-ecosystems under different pedological and climatic conditions. To do so, we propose to develop a set of time and cost-effective techniques (name BIOFONCTOOL) to assess functional parameters related to the targeted soil functions

Methodological objective: to set up a set of functional tests to characterize the following functions: OM mineralization, (lamina baits) and nutrient cycling (resine) soil fauna activities (litter description) humus descriptions

RESEARCH OPERATIONS

NB: we will only describe in this part the experiment set up in 2014 on rubber, others tree like teak and Acacia will be potentially (depend on budget constraints) targeted in the future

The project is subdivided in 4 research operations. We will described for each the title-problematic- specific objective- localization-experimental design and methodology main results and the students involved

Operation 1

Organic matter dynamic and soil bio-functioning in Rubber plantation

➢ Problematic of the study

This project is link to the importance of rubber litter quality on soil functioning. We address this question because

- Belowground processes in terrestrial ecosystems are driven by a variety of factors, among which the quality of litter inputs is one of the most important.
- Ongoing forest development with aging trees is characterized by substantial shifts in humus morphology, soil fauna soil microbial community composition and nutrient cycling efficiency
- The importance of tree age as a determinant of intraspecific variability of litter quality has been poorly addressed.

➢ Objective of the study

Assess the role of plantation age in rubber plantation on intraspecific variability of the litter in different pedoclimatic conditions.

➢ Question of the study

- What is the effect of plantation age on OM mineralization?
- Does litter quality vary with the age of the plantation, and if so, what are the consequences of this variation on the nutrient cycling and soil functional biodiversity?

➢ Localization

Chachoengsao province, Sanam Chaiket district

➢ Experimental design and methodologies

The work is currently done in rubber chronosequence containing tree classes of plantation ages (5-7y/12-15y/> 25y)

- OM mineralization patterns was assessed using
  - Litterbags with 2 different mesh (1 cm. and <0.2 mm) to assess the role of the soil fauna on OM mineralization rates. The litterbags are sampled every two months (may to December)
  - Bait-lamina test: it's a method which provide a comparable, quick and inexpensive screening of the soil biological activity (www.terra-protecta.de) This year, we will mostly test its used in different context.
  - Morpho-functional diagnosis or 'litter diagnosis". This method consist to describe the topsoil layers encountered in the field (see full methodology in appendix G
  - Litter quality will be assess using Van Soest (KKU) and NIRS methodology (LDD-KKU-KU)
  - Soil fauna evolution will be assess using TSBF conventional method (Tropical Soil Biology and Fertility) (Lavelle, 1988)

➢ Main results

the experiment (litter bags) start in June and will end in December. The soil fauna characterization together with the lamina baits and litter diagnosis will be done in November during the LMI training on soil biodiversity.

➢ Valorisation:

Data sets is currently under acquisition.

- Problems encountered: We did not find any laboratory to assess the litter quality using Van Soeast technology, we will send this litter to David Sebag to do litter quality using Rock Eval.
- Perspectives 2015

- Setting up microcosm studies to determine the respective impact impact of litter quality on the soil microbial structure and activities.
- Establish a same kind experiment in South Thailand and in Buriram
- Characterize the litter quality of Rubber tree with different ages
- Write a first paper on litter degradation and OM decomposition in Rubber tree plantation

- Students involved:

- Ms. Pusanisa Heepngoen, PhD student Kasetsart University
- Ms. Promnok Treenuch (KKU), master Student KKU for soil fauna analysis.

This study benefit from the support of LDD staff (for soil and microbial analysis), KU and CIRAD (litter analysis, exchange resins).

Operation 2

Impact of tree plantations on the soil ecosystem: Case of rubber plantations in Chachoengsao province, Thailand

- Interest of this operation

In the last decade's rubber plantations replaced many farming systems as traditional subsistance agriculture or commercial crops. Despite these major changes, the impact of this land uses changes on soil functioning is not yet studied.

- Objective

- To study the environmental impact on soil biodiversity of the replacement of an annual crop (cassava) by a rubber plantation.
- Evaluate the importance of plantation age on the soil biodiversity and activity.

- Localization

This work has been leaded in Rubber planation in the Chachoengsao Province, located at 13°35"N and 101°27"E. This area has a tropical climate, 1200 mm precipitation per year mostly allocated between June and September. The clone used in this area is RIM 600

- Methodology

A chonosequence containing four classes of plantation ages have been selected around Chachoengsao Rubber Research Center. Three cassava fields, which represent the previous cropping, represent the former land uses.

- Variables measured
  - Soil physical parameters (Inter- row and Row) (pH, Nm , P, K, OM, C ,N)
  - Soil resistivity using Electron tomography (done by Henri Robain)
  - Soil microbial activity (by measuring soil catabolic profile using Microresp™ techniques)
  - Soil bacterial and fungal diversity using high throughput rRDNA sequencing technics (pyrosequencing)
  - Soil macrofauna diversity using TSBF methodology (see operation 1)
- Main results
  - Compared to cassava, all biological parameters are significantly higher in the old rubber plantations (20-25 years). This old plantation harbored a specific fauna and microbiota
  - The plantation age has a deeper impact on soil biodiversity and activities than the shift induced by land uses changes (from cassava to rubber)
  - It takes more than 10-12 years (canopy closure) for the rubber plantation to restore the same level of biological activity and diversity found in the cassava plantation.
  - The low diversity of soil fauna measured in young plantations originated from intercrop management (pineapple)
  -
- Valorisation

Oral presentation to congress

See list publications in Appendix B

- Congress/Seminar number: 14,4,6,3,7,18,8,15
- Report number:1

- Problems encountered

We were not able to sample the nematodes, the nematode's surveys will be done in November 2014

- Perspectives 2015
  - Finalize the nematodes analysis and statistical analysis of the data
  - Write two papers (one on macrofauna and another one on soil microbial communities)

- Student involved
  - Ms. Monrawee Peerawat, LDD researcher, PhD student at Kasetsart University
  - M. Lafaye de Micheaux, AgroParisTech, Gap year engineer international internship. 2013

Operation 3

The impact of agricultural practices on soil functional biodiversity: the rubber tree cultivation case in Thailand

➢ Interest of the study

Planted area with *Hevea brasiliensis* expands rapidly in marginal area such as NE Thailand, in terms of climate (too dry) and soil properties (too sandy). We hypothesized that in this specific pedo-climatical context for Rubber Plantation, practices which preserve soil biodiversity and activities, are a key to maintain soil functions and thus soil sustainability.

➢ Objectives

- To determine the impact of agricultural practices on soil functional diversity and activities
- To select within different soil biological actors the best bio-indicator linked to the level of soil perturbations induced by agricultural practices.

➢ Experimental principle and methodologies

- We measured the occurrence of three major groups of soil organisms (macrofauna, nematofauna, microorganisms), submitted to a gradient of intensity of land management practices
- Samplings were made on 12 representative plots in Khon-Kaen region, that present similar pedo-climatic, statements, within
  - ➢ (i) two levels of practices intensity, high and low
  - ➢ (ii) two levels of plantation's age, based on rather or not latex tapping is possible (immature <6 years old, mature > 9 years old).

➢ Main results

- Plantations with low intensity practices were characterized by a high level of macrofauna activity (earthworm casts, high percentage of degraded litter).
- Plantations with low intensity practices (mature stage) showed an increase
  - ➢ In abundance of soil engineers (termites, earthworms) and fungi feeders nematodes
  - ➢ Bacterial biomass of the metabolic spectra of soil microorganisms
- Plantations with a high intensity practices (immature stage) were characterized by a high level of perturbation (reveal by the nematode's trophic index) and the presence of Diplopoda and Blattidae
- Intensive agricultural practices had generally negative effect on soil biota, homogenizing microbial catabolic structure, nematodes functional structure and restricting functional diversity for all groups of organisms studied.
- Mature rubber plantation showed a higher level of stability (more complex food web), which seemed to buffer the perturbations induced by agricultural practices
- Functional diversity seems a more reliable indicator of soil ecosystem disturbance than ecological index based on taxonomical affiliation

➢ Valorisation

See list publications in Appendix B

- Congress/Seminar number: 10,21,13,20,16,17
- Report number:2,3

➢ Problems encountered

The number of repetition (3 fields by treatment) was sometimes too low to get significant differences within the different practices.

➢ Perspectives 2015

- Extend this study to other pedoclimatic context (Laos and South Thailand)
- Publish the results

➢ Students involved

- Ms. Monrawee Peerawat, LDD researcher, PhD student at Kasetsart University
- Promnok Treenuch (KKU), master Student at KKU
- Vladislav KYULAVSKI, Master Student, Paris Université PARIS EST CRETEIL, Master Bioressources
- Milena Till Stage Ingénieur INP Toulouse Purpan.

Operation 4

Impact of rubber intercropping on soil nutrient cycling and soil bio-functional diversity

➢ Interest of this operation

Our previous work (see Operation 2) showed that inter-cropping has an important effect of soil bio-functioning. Moreover, legumes could provide a complete cover and thus protect the soil from erosion. External benefits expected are nitrogen fixation, soil moisture retention, minimization of weed growth, increase of organic matter, reducing of nutrients loss, moderating soil temperature and improving soil physical properties.

➢ Objective of the study

- Compare the effect of legume's intercropping to cassava intercropping on parameters link to soil and plant functioning
- Select within different legumes 3 legumes the most efficient one in terms of N transfer, soil nutrients, soil biodiversity and activities, soil moisture, tree growth etc..

➢ Research Questions

Does intercropping management have a positive or negative effect on nutrient bioavailability for plants, on soil functional diversity and nematode's pathogens density.

- Localization

Buriram province, near Satuk[1] city (NE Thailand) in a rubber plantation of 2 years old own by Mr Vichit:[2] previous crop Eucalyptus, Crop clone RITT 251, Plot size 25 rai ~2,5 hect

- Experimental design and methodologies

Experimental layout consists of 4 blocks with 5 treatments (see table below). The working area consists of 7 tree and 4 rows by treatment.

Cassava	***Mucuna bracteata***	***Calopogoniu m caeruleum***	***Pueraria phaseloide***	***Control***
Control	*Cassava*	*Calopogoniu m*	*Mucuna*	*Puerari a*
Pueraria	*Calopogoniu m*	*Cassava*	*Mucuna*	*Control*
Calopogoniu	*Mucuna*	*Control*	*Pueraria*	*Cassava*

- Variables measured

- Meteorological data are recorded using a climatic station (Davies)
- Classical Soil physical parameters (Inter- row + row) (pH , P, K, OM, C ,N) + Soil resistivity using ERT (electron tomography (done by Henri Robain in September)
- Soil water content using sensor Sentec in each row-inter row + mobile sensor
- Hydric potential using Tensiometers (need to be install)
- Soil biological parameters using same methodology as previously described (operation 2)

- Main year's achievements

This year was devoted to the:

- January-March: Visit of Satuk fields, layout design, choice of legumes and agronomic layout with the Khon kaen research team
- April: Setting up of the field equipment (climatic station, PVC tubes for Sentec measurements etc.)
- May: Implementation of the agronomic layout to clearly identify the working area (clear identification of the plot layer, tagging of the trees etc..)
- June: First to soil survey (physico- chemical characteristic, soil fauna, nematodes)
- End of August: Setting up of the intercrop plantation's (planting legumes and cassava, take of weeds etc. Fertilization of the plots following local)

1 GPS point: 15° 13'52.3" N/103°18'32.9"E,

2 a farmer who start growing difference legume inter crop in the rubber tree plantation since 2001 – 2014

- August to October: Measurement every 15 days of some key parameters, such as soil moisture, leaf water potential, tree girth etc.)

➢ Valorization

Data sets are currently under acquisition.

➢ Problems encountered

Heavy rain in July and beginning of august did not allow the planting of the legumes. Mucuna faces some germination problems so we need to set up a nursery before planting it in the field. Some crows eat the nutrient and take of cassava stalk.

➢ Perspectives 2015

- Characterize the effect of intercropping after one year on soil physical and biological characteristics together with physiological tree characterization (LAI, Leaf nutrient contents, tree girth)
- Measuring every months soil and tree key parameters

➢ Students involved

- Ms. Monrawee Peerawat, LDD researcher, PhD student at Kasetsart University
- Promnok Treenuch (KKU), master Student KKU for soil nematofauna analysis.

Operation 5

Inventory and roles of rhizosphere microbial communities in supporting soil fertility and plant nutrition in rubber plantation

➢ Interest of this operation

Rubber tree (Hevea brasiliensis) is a crop of major socio-economic importance in Southern Asia as it represents a substantial source of income for small land holders. In Thailand (1/3 of world latex production) rubber tree plantations are currently greatly expanding in adverse eco-climatic zones, especially in Isan provinces, where soils have sandy texture, low fertility and are prone to erosion and leaching of applied fertilizers. A major potential for increased production in these conditions relies on the important roles of rhizosphere microbial communities in supporting soil fertility and plant nutrition. ***The improved understanding of the diversity of root-associated microbes will contribute to the development of alternative sustainable practices to improve and sustain soil fertility.***

➢ Objective

- Characterize the rubber rhizosphere microbial community (total bacterial and fungal communities, nematodes, arbuscular mycorrhizal fungi) along a chronosequence (3, 6 and 16 year-old plantations)
- Assess the impact of increasing doses of biochar on soil chemical and physical properties and microbial diversity (bacteria, fungi, beneficial microorganisms)

➢ Methodologies

- Objective 1: A chronosequence of 3, 6 and 16 year-old plantations was identified in Ban Don Chang village and cassava fields were used as no-rubber controls for comparison. Soils from each treatment were characterized for texture and chemistry. Using 454 sequencing, total bacterial and fungal communities as well as arbuscular mycorrhizal fungi (AMF) community were analyzed. Because they are known to contribute to plant P and N nutrition by increasing mineral nutrient availability or by enhancing plant nutrient uptake, root-interacting P-solubilizing bacteria (PSB) and free living N fixing bacteria were assessed after culturing on selective media. Nematodes populations were characterized as there are good soil fertility indicators. Functional traits were also analyzed by both qPCR and Ecoplates (Biolog) methods.

- Objective 2: a trial has been set up in April 2013 in Phu Wiang to assess the impact of increasing doses of biochar made from bamboo. Doses of biochar ranked from 0 to 20 tons/ha, and the trial consisted in 4 replicates per treatments with 12 trees per plot. Several parameters are measured every 6 months, including the chemical and physical properties and the diversity of bacteria and fungi in soil or within roots (AMF). Potential PGPR (N-fixing and phytate solubilising bacteria) have also been identified
.

➢ Main results

- Objective 1:
  - ➢ This study show significant differences between rubber and cassava associated communities but didn't reveal a strong impact of the age of the plantations on the different communities
  - ➢ the AMF community in cassava roots was twice as rich as in rubber tree samples but was not affected by the age of rubber trees.
- Objective 2:
  - ➢ Preliminary results show that biochar has no effect on the measured parameters one year after application, which confirms the hypothesis that biochar requires time to induce significant changes in soil. The last sampling will be done 28 months after application and significant impacts of biochar may be expected

Operation 6

Consequences of the extension of rubber tree plantations on land use functioning and farmers' income in Northern Lao PDR (Luang Namtha province)

➢ Statement of the problems

- Rubber has very rapidly growing Luang Namtha Province, Northern of Laos. The province has the impact from promotion commercial tree plantation and cross border trade between neighbouring country of Laos.
- Land use in Luang Namtha province has changed very fast from traditional shifting cultivation to rubber plantation. There were three type of system such as concession, contract farming and self-investment. Rubber is only an activity that farmers would have better income in the long run. However, it is an uncontrollable activity and rapidly expands.

- The main question of this study is to see how function of the land using for rubber plantation with different geographic condition, climate, soil type and previously land cover.
-

➢ Objective of the study

- Assessment land use change for rubber plantation in the watershed level particular to identify the ecosystem service change: food source, water use, NTFPs, timber and biodiversity and livelihood changes such as income and culture of local people.

- Examine land use functioning for rubber production such as soil structure, erosion, soil functional biodiversity and nutrition cycling, etc.

➢ Research questions

- How and why the lands were changed to rubber plantation?
- What are factors influence of the change?
- How the livelihood of rubber and none rubber farmers in the same landscape (watershed) were affected on food and income?
- Do rubber affect to biodiversity and soil structure?
- How the farmers maintain the land in long run?
- What is the good option to maintain rubber landscape?

➢ Methodology

Our research will be conducted in Luang Namtha province because it is representative of the multiple ecological and economical changes occurring in LaoPDR. Moreover, this province is where rubber plantations started their expansion (since 1995) and still expand, but it also contains the Nam Ha National Biodiversity Conservation Area (NBCA) installed in 1993 (being thus, one of the oldest biodiversity reserve from ASEAN). This reserve should be secured by the incomes it generates in relation with ecotourism, but this province is also on the way of the highway and railway that could link in a near future the Chinese city of Kunming (Yunnan) to the harbor of Bangkok (Thailand), an economical opportunity but an environmental major threat.

- Location and site selection

The study has selected a watershed in Luang Namtha district of Luang Namtha province to be a case study as following:

The total area of watershed was 663 ha, land use was classify into three type such as forest and rubber plantation and paddy field.
Presently, I am review some study in Luang Namtha as following workplan

TRAININGS LINK TO THE PROJECT

Training1.

Title

Characterization of the physiological profiles of the soil microbial community

Interest

Most of the measurements today are related to the characterization of the molecular diversity of microorganisms. But if it's important to determine who is there? (diversity), it's even more essential to understand what do they do (metabolic activities)? This will be the aim of this training

Objectives

Characterize the metabolic profiles of the soil microbial community, using microresp^{TM} method developed by

Campbell et al. (2003) and analyses the data in order to measure

- The microbial biomass
- The respective catabolic activities of fungal and bacteria

Localization and date.

02 to 04 April 2014 Platform of LDD- LMI LUSES

List of Participants

18 participants; 15 Thai (LDD,KU,KKU) 2 Lao (NAFRI-NuOL), 1 Viet (SFRI)

Trainers

Tiphaine Chevalier (IRD, LUSES, UMR ECO&SOLS),

Josiane Abadie (INRA, UMR ECO&SOLS),
Pascal Alonso (IRD, LUSES, UMR ECO&SOLS-,
Monrawee Peerawat (LDD, LUSES)

Budget

List	Amount
Training Organization	1,180.00 €
Participants accommodation	1,168.00 €
Equipments	485.00 €
Total	**2,833.00 €**

Main output

- Theoretical aspect of the microresp™ method has been exposed
- Each participant has been initiated to all practical aspects of the microrespTM method (preparation of microplate, prepare substrate solutions, calibration curve tech). (see annex X)
- A calculation method of microbial biomass and a booklet describing the different steps of the microresp™ techniques has been given to all the participants
- Statistical aspect of data analysis has been exposed

Training 2

Title

Soil biodiversity and activity: from sampling to data analysis

Interest

The originality of this training lies on the packed continuous work from field tasks like soil and fauna sampling and description, laboratory tasks to data exploitation using statistical analyses. This training will provide important and central ecological tools for students in the analysis of land uses impacts on ecosystem services.

Objectives

- Learn how to sample, identify and characterize the soil macrofauna
- Characterize the impact of this macrofauna fauna via the
  - Description of the humus layer of the soil (the humus index)
  - Characterization of the SOM degradation patterns (lamina baits techniques

Localization and date.

- From 3 to 7 of November: Site Rubberflux, Chachoengsao
- From 10 to 14th of November: Kasetsart University and LDD LUSES biologic platform

List of Participants

13 participants; 10 from Thailand (LDD,KU,KKU) 2 from Lao (DP CIRAD Cansea), 1 from Vietnam (SFRI to confirm)

Trainers

- Dr. Jean Trap (IRD UMR ECO&SOLS)
- Pr. Thibaud Daecans (Univ. of Montpellier 2 UMR CEFE)

- Dr. Alain Pierret (IRD UMR IESS),
- Dr. Alain Brauman (IRD, ECO&SOLS)

Main output

- Identification of soil macrofauna using identification key provides by the Pr. Thibaud Decaens
- Methodology to achieve a morpho-functional diagnosis or 'litter diagnosis" in any perenial ecosystem
- Characterization of the SOM degradation patterns using lamina baits techniques)
- Know how to analyse statistically the data using free statistical software like R

BUDGET REPORT

Tree plantation	IRD	Co funding	Total	% co-funding	Origin co-funding
Collective training	3 396 €	16 265 €	19 662 €	83%	IFC, CRCC,YARA,HRPP,TICA LDD, TICA KU, Cansea, ECO&SOLS
Individual support	1 910 €	3 300 €	5 210 €	63%	TICA KU
Field and laboratory works	3 437 €	21 132 €	24 570 €	86%	IFC, YARA,HRPP,TICA LDD, TICA KU, EO&SOLS
Total	8 743 €	40 698 €	49 442 €	82%	IFC, CRCC,YARA,HRPP,TICA LDD, TICA KU, Cansea, ECO&SOLS

This project is link to several others project funded by or private companies (French Inst. of Rubber, YARA), Asian institutions (TICA project LDD, TICA project KU) and French ones (CIRAD, UMR ECO&SOLS). This explain the high percentage of co-funding (82%) of this project. This level will hopefully remain quite high next year. was unusually high this year (82%)

COMMENTS

Two projects link to the same topic has been accepted in 2014: Young research team ECO-RUBBER funded by IRD and Heveadapt funded by the French ANR. This two projects will facilitate the extension of this program to Lao partners (ECORUBBER) and to others French partners (ANR)

Appendix G: Report of LMI-LDD Platform Opening Ceremony

On 22 May 2014, which correspond to LDD's 51th anniversary, Our LMI LUSES partner, the **Land Development Department** organized an opening ceremony of regional platform of Microbiology LMI LUSES at Land Development Department central office.

The General Director of LDD. Mr Apichat provided a warm welcome to Stéphane Roy, Attache for Science. and Higher Education at the French Embassy, Dr. Jacques Berger, Representative of IRD Thailand, Dr. Marc Souris, Representative of IRD Lao PDR and M. Damien Jourdain, representative of CIRAD and to Alain Brauman, co-director of the LMI LUSES with Nopmanee Suvannang from LDD.

The ceremony began by a speech of the IRD representative who first deeply thanked the General Director of Land Development Department, Mr Apichat and the Deputy Director Mr. Anusorn, for inviting him, as IRD representative, to participate to this opening ceremony of the LMI LUSES Platform of Microbiology.

He also underlined the fact that the collaboration between the LDD and IRD is based on a long historical partnership originated by our IRD colleagues Roland Poss, who was the first

IRD researcher posted at LDD in 1995. Roland passed away recently but he would have been proud of the spirit of this efficient collaboration with LDD partners.

Now this long term partnership has been moved one step forward with the implementation of this new IRD Tool called LMI, for “Laboratoire Mixte International” in French or “International Joint laboratory” in English. In short the LMI LUSES standing for “LAND USES and SOIL ECOSYSTEM SERVICES”, aims to develop multidisciplinary research and training in soil ecological sciences **on a regional scale**. (LaoPDR, Thailand and Vietnam). This is why the LMI included 7 south east Asian institutions or universities. Its scientific objective is to tackle the agriculture environmental impact on soil, in south east Asia (LaoPDR, Thailand and Vietnam), a main issue for the LDD and all Asian farmers!

This speech was followed by the speech of Mr Anusorn Chantanaroj, deputy director of the LDD, who acknowledged IRD for this long term collaboration with LDD under the Framework of the TICA agency (Thailand International Cooperation Agency). He underlined that one of the keys for the success of the association between LDD and IRD under the LMI

framework, is relying on the possibility to develop soil microbiology analyses, a major component of soil fertility for developing a more sustainable agriculture. Both the LDD and the LMI LUSES, with the support of IRD and CIRAD, joined their efforts to create this performing well equipped microbiology platform, that have been officially opened the 22th of May 2014.

The speech was followed by a symbolic curtain opening, which was covering the LMI LUSES -LDD banner by the DG of LDD, Mr Apichat, the Attache for Scient. and Higher Education M. S. Roy and the IRD representative Mr J. Bergé.

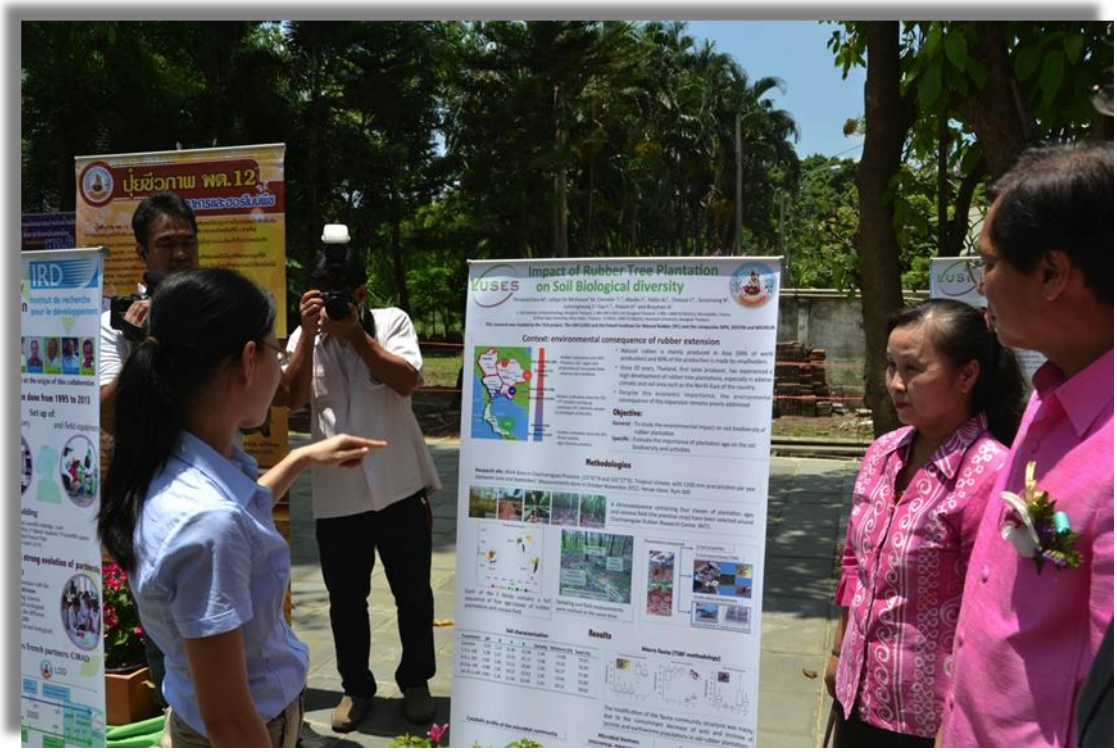
Then, a visit of the laboratory was organized with Mrs Supaporn, Director of the biotechnology division of LDD, Mr

Alain Brauman, LMI LUSES director from IRD and Mr Pascal Alonso, IRD expert in Molecular Biology.

This laboratory visit was followed by a poster presentation which described the long term IRD-LDD partnership presented by Henri Robain from IRD,, the head of the ongoing TICA project

The LMI LUSES objectives and LMI-LDD microbial platform, description by A. Brauman,

And an example of the work done in the platform by Ms. Peerawat, LDD researcher and LMI PhD student.



As usual, the ceremony ended up with a lunch offered by the LDD, to all the participants.

•

Appendix H

Abstract of project accepted in 2014

1) French ANR Hevea-Adapt

2) JEAI Eco Rubber abstract

1) French ANR Hevea-Adapt

Tropical tree plantations provide indispensable renewable goods to the global market and family farms represent the majority of their surface area and production.

To ensure the sustainability of plantation systems, environmental and socio-economic conditions should remain favorable during several decades. How can such conditions be ensured when the environment is changing? Even if the local consequences of global increase in temperature are difficult to assess, there is a consensus that the farmers will have to face a more variable climate, with probable changes in rain patterns.

Moreover, all natural resources have recently faced hugely variable prices related to variations in global demand. High prices attract new investors and drive the extension of plantations into new areas, inducing land-use changes and changes in farming structures.

The final aim of the project is to analyze how smallholder's tree plantations can adapt and keep sustainable whereas they face variable climatic conditions and deep changes in their socio-economic context. Do farmers perceive these risks and do they initiate adaptive strategies? Rubber tree-based systems in Thailand will be used as a model of tropical family plantations integrated in a major global commodity channel. The project will assess both the specificities of rubber cropping and the more general features of tree plantations.

The originality of the project relies on the multi-disciplinary approach of both the characterization of changes and their consequences on rubber plantations and the related risks for farmers. Plant and soil sciences will be associated to social sciences and economics. We will analyze the way socio-economic factors interact with biophysical factors to determine farmers' vulnerability or adaptability to changes. This will require the identification of relevant indicators to measure farmers' adaptation, and the impacts of changes on sustainability and resilience of the systems. We will refer to the 'Sustainable Livelihood Framework' (Ellis, 2000) to represent the household/holding units, combined with the OECD risk matrix (2009) to assess households' viability. We will focus on two major factors, (i) the type of holdings, particularly the emergence of new investors and (ii) the share-cropping contractual arrangements that frame the management of plantations.

The main biophysical risk relate to climate changes and due to the extension of plantations in new and more adverse areas. We will evaluate

the risks at plot or farm levels (plantation sustainability), as well as outside the plantations (potential externalities), in terms of soil sustainability (soil fertility preservation related to soil physical quality and soil functional diversity) and tree adaptation to water stress. Specific ecological constraints linked to the different cultivation area will be considered. In the North-eastern rubber extension area, the climate is drier and the soil fertility is low, whereas in the traditional area (South) continuous rubber cropping occurs for more than 50 years (third cycle). In the North, the specific issue of rubber installation in montane area will particularly focus on the effects of terracing, considering the impact on water flow and water balance.

A typology of rubber farming systems will be created from socio-economic survey, particularly regarding land management and latex harvesting systems. The impact of practices on soil physical and bio-functioning will be evaluated through specific indicators that will be developed or adapted in the perspective of multi-criteria evaluation of plantation systems.

Beside the specific case of rubber plantations, a more generic output of the project is to determine, through modelling and risk framework analysis, the most significant indicators to be observed to assess the long-term adaptation and sustainability of tree-based family farms.

2) JEAI Eco Rubber abstract

Title: **Soil functioning changes under tree cultivation: the case of rubber tree in North-East Thailand and Laos.**

Keywords: **tree plantation, rubber tree, soil biodiversity, soil quality, ecosystem services, carbon sequestration, socio economics issues**

Land use is changing rapidly in Thailand and LaoPDR: a fast expansion of commercial tree plantations is observed, particularly rubber tree (*Hevea brasiliensis*) plantations, due to the increasing demand for natural latex on the international market. Despite the economic importance of rubber tree plantations in South-East Asia (SEA), their social and environmental impacts are still poorly studied. In LaoPDR there is a transition from conservation forest to rubber tree whereas in Northeast Thailand the transition is from annual cash crops to rubber tree. To determine whether rubber plantations induce environmental degradations or improvements, the scientific objective of this project is to specify the impact of these land use changes (forest or crop transition) on soil functions related to ecosystems services as well as socio agronomic issues.

This project on the environmental consequences of rubber tree plantations (LUC) will be organized around four work packages: i) socio-economic consequences ii) soil functional diversity, iii) nutrient cycling and iv) carbon sequestration. The measurements will be undertaken in rubber tree plantations of different ages (chronosequence) or with different management practices. To study these complex and interrelated aspects, our project associates Thai and Lao lecturers and researchers with complementary skills: socio-agronomist, agricultural system specialists, tree physiologists, agronomists, soil ecologists, soil physicists and soil microbiologists. The goal is to strength the capacity building of this team, in order to study the environmental impacts of any other land use change in the future. Moreover, the skills of this team will be useful beyond the borders of the two involved countries because ecology and particularly soil ecology is still poorly taught in SEA. Giving an ecological perspective in agronomical science is particularly relevant in SEA, which undergoes constant land use changes du to economical constraints. IRD's support will help providing a theoretical and practical background in soil ecology and in recent analytical techniques.

Besides scientific publications, one of the main building capacity outcomes of this project will be (i) the reinforcement of Lao scientific

community via the supervision of Lao PhD and masters students.(ii) the building up of an regional (Lao-Thaie) young expert research team able to address future environmental management challenges in SEA. One of the expected key academic outcomes will include the development of a master module on soil functional ecology (with common curriculum at KKU and NUOL); a practical outcome will be the suggestion of sustainable practices for the management of rubber tree plantations and associated soil resources.

Appendix I

Report of Collective training 2014

1. MicroResp technique
2. Soil fractionation
3. Biofertiliser
4. On-the-job training ECOFILTER
5. Soil Biodiversity

1) MicroResp technique

Title : Characterization of the physiological profiles of the soil microbial community

Date : 2st to the 4th of April 2014

Participants: 18
10 from LDD, 2 from KKU, 3 from KU, 2 from Nuol (Laos) , 1 from SFRI (Vietnam)

Trainers:

- Tiphaine Chevallier: Senior soil scientist, IRD, UMR ECO&SOLS, France
- Josiane Abadie: technical assistant, INRA, UMR ECO&SOLS, France
- Pascal Alonso: TICA temporal expert, in charge of the microbial lab. IRD, posted at LDD
- Monrawee Peerawat: LDD soil scientist, Biotechnology Dept.

Localization: LMI-LDD platform of microbiology

Funded by: LMI LUSES, UMR ECO&SOLS, French Rubber association, LDD Biotechnology Dept.

Cost of the training: 6000 € (~265000 bath)

Context of this training

The LMI LUSES and its LDD Partnershas developed since 2012 acommon platform of microbiology within the Biotechnology department of LDD. The aim of this laboratory is to characterizethe soil microbial compartment of the soil subject to different perturbations (land uses, farmers practices, organic matter management such as biochar etc..). Why this focus on soil microrganisms, because, there are more microbes in a teaspoon of soilthan there are people on the earth. Soilscontain about 8 to 15 tons of bacteria, fungi, protozoa, nematodes, earthworms, and arthropods. They (microorganisms) are the main driver of the nutrient cycling (90%) their characterization is thus critical to better assess the soil functioning. This platform will allow to determine what kind of agricultural practices or organic matter management are more sustainable for the farmer. However, most of the measurements today are related to the characterization of the molecular diversity of microorganisms. But if it's important to determine who is there? (diversity), its even more essential to understand what do they do (metabolic activities)? This will be the aim of this training

Methodology: the microrespTM method

To assess the metabolic profiles of the soil microbial community, we choose the MicroResp™ method developed by Campbell et al (2003) which combines the advantages of Biolog™ (without the drawbacks) and those of the SIR (Substrate

Induce Respiration). It consists of a miniaturized measuring device for measuring the CO2 production of the total microbial community in soil, induced by the addition of various carbon substrates during a short incubation. This technique allows to determine the profile of catabolic a microbial community It also allows to estimate the soil microbial biomass by measuring the respiration induced by glucose.

Short description of the training

The training will last 3 days, the first day will be devoted to the theoretical aspect of techniques for assessing the soil activities, the two others days will be devoted to measurements and analyses of the data produced.

See the schedule with pictures below.

How to improve?

The training was globally appreciated by trainees and trainers. All people were interested in the training, ask lots of question. Some of them said that they would practice the techniques in their lab. Nevertheless, some improvements have been suggested by trainees:

- Less trainees, not more than 10 could be fine to practice the techniques
- Have all the documents printed before the training (lecture and protocols)
- Follow carefully the schedule planned
- The calibration curve has not been showed properly because of supply delays (bottle of CO_2 was not delivered on time)
- Be careful of the English speaking of the trainers
- The exercises on the data analysis were not explained to everybody at the end of the training but to each group. It would be better to explain the analysis to all people at the same time

MicroRespTM training

come ceremony

oretical part

- Presentation of the objective of the training : Alain Brauman (theory 30 minutes)

- How to measure soil biological activity? (theory 1h-2h)
  - *Soil organic matter*
  - *Soil microbial activity*

- *CO_2 emissions measurement*
- *Soil microbial activity and diversity (soil microbial functional diversity)*

- Presentation of MicroRespTM technic (theory 30 minutes)
  - *Principle of the method*

roplate preparation - Gel (Practical 1h)

- Gel, color indicator, how pour microplate without bubble
- Incubate overnight plate

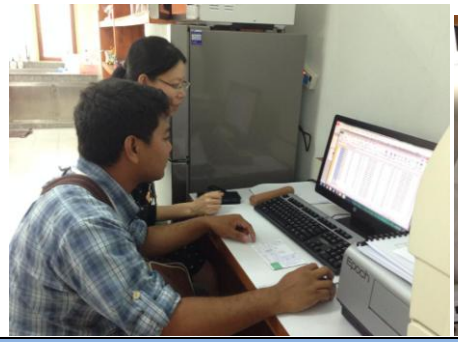
and substrate preparation, Calibration curve (Practical 1h00)

- Filled the microplate, which substrate? prepare substrate solution, and antibiotic solution, design the soil microplate

l and substrate preparation (Practical 1h00)

- Soil humidity, add substrate ?, Antibiotic application
- First Gel reading

- Closing MicroResp system (soil microplate and gel microplate)




bration curve (theory30 min, Pratical30 min)

- Presentation of 2 methods of calibration
- Preparation of the calibration

cussion and questions about the method

a analysis (theory, 1h30)

- Data presentation
- Microbial Biomass

asures (Practical 30 minutes)

- 6h after closing MicroResp system or calibration curve preparation Final gel reading

culation (Practical 1h30)

- Calculate the calibration equation
- Calculate the data







a analysis (Practical 1h30)

- Data analysis

2) Soil fractionation

Title : Soil Organic Matter fractionation

Date : 8th to the 10th of April 2014

Participants: 15
12 from LDD (6 from soil physics lab, 6 from soil chemistry lab), 2 from KU

Trainers:

- Tiphaine Chevallier: Soil scientist, IRD, UMR ECO&SOLS, France
- Nopmanee Suvannang: Co-director of LMI LDD, Director of Soil Analyses Technical Service


Localization: Laboratory LMI- Biotechnology Land Development Department

Funded by: LMI LUSES, Biotechnology Land Development Department

Context of this training

Soil organic matter nature and the soil spatial heterogeneity due to intimate interactions between the soil physical matrix, soil organic matter, and soil biota need to be characterize to understand soil organic matter dynamics or microbial habitats.

Methodology: Soil Organic matter fractionation
2 methods were presented: (i) soil fractionation with maximal dispersion to characterize soil organic matter stock (organic matter particle size fractionation) and (ii) soil fractionation into aggregate size.

The principle is to separate a soil sample into different soil particle-size fractions with no SOM destruction. Soil organic carbon and nitrogen content is measured on each particle-size fraction. Other analyses (microbial communities…) could also be done, especially when soil is separated in aggregate size class.
Soil is dispersed in water and sieved at 200, 50 and 20 µm. Coarse fractions were separated in organic and mineral fractions. The soil 0-20 µm is separated in 0-2 µm and 2-20 µm by sedimentation.

Short description of the training

The training will last 3 days, the first day will be devoted to the theoretical aspect of techniques for assessing the soil organic matter stock, the two others days will be devoted to measurements and analyses of the data produced.

Soil Fractionation training		
Tuesday 8th April	**9h00 12h**	**Theoretical part**
		Presentation of the objective of the training : Alain Brauman (theory 15 minutes) Presentation on soil organic matter (in English by Tiphaine Chevallier, in Thaï by Nopmanee Suvannang) - Different pools of soil organic matter - Different way to characterize these pools - Different research questions -> different fractionations (in particle size class or in aggregate size class) Presentation of fractionation technic (in English by Tiphaine Chevallier, in Thaï by Nopmanee Suvannang) - Maximal dispersion technic - Separation in soil aggregates technic
	13h30 - 14h30	**Preparation of soil samples dispersion (Practical 1h)**
		Soil + water + HMP + marbles + shaking
	15h00-16h00	**Preparation of material for the day after**
		Tare (Weigh) vessels
9th Wednesday April	**8h00-12h00**	**Shaking of the soil preparation for 4 hours**
	13h30-16h00	**Sieving procedures**
		- 200 µm - 50 µm, 20 µm - Separation organic and mineral fractions by floatation
Thursday 10th April	8h00	**Fraction smaller than 20 µm**
		- 2 methods, isolate the 2-20 µm or not, start of sedimentation (Stocke's law)
	9h00-11h00	**Data analysis (Practical and theory)**
		- Excel file to fill with data and calculation, Examples - in English by Tiphaine Chevallier, in Thaï by Nopmanee Suvannang)
	11h00	**Discussion about the method of soil aggregates separation**
		in English by Tiphaine Chevallier, in Thaï by Nopmanee Suvannang)

3) Biofertiliser

1	**Name, position and contact details trainer(s) (incl email)**
	Dr Lambert Brau School of Life and Environmental Sciences Faculty of Science and Technology Deakin University 221 Burwood Hwy, Burwood, Victoria 3125 Australia Phone: +61 3 9251 7055 Fax: +61 3 9251 7626 lambert.brau@deakin.edu.au Dr Didier Lesueur Senior Soil Microbiologist, CIRAD, UMR Eco&Sols (CIRAD-IRD-INRA-SupAgro) Land Development Department Office of Science for Land Development, Paholyothin Road, Chatuchak, Bangkok 10900 Thailand Phone: +66 2561-2778 #14 Fax: +66 2561-2186 didier.lesueur@cirad.fr Ms Laetitia Herrmann PhD Canidate, Deakin University Land Development Department Office of Science for Land Development, Paholyothin Road, Chatuchak, Bangkok 10900 Thailand

THE CRAWFORD FUND

	Phone: +66 2561-2778 #14 Fax: +66 2561-2186 lherrmann@deakin.edu.au Dr Lee Hudek Research Fellow School of Life and Environmental Sciences Faculty of Science and Technology Deakin University 221 Burwood Hwy, Burwood, Victoria 3125 Australia lee.hudek@deakin.edu.au
2	**Title of training project, location and dates of training**
	Capacity Building for beneficial microbes in agriculture in Laos, Cambodia and Vietnam Land Development Department Office of Science for Land Development, Paholyothin Road, Chatuchak, Bangkok 10900 Thailand April 21 to April 25, 2014
3	**Training activities (**please provide an account of training activities)
	The course gave participants a sound understanding of microbiology, how to grow, purify and store bacteria and how to identify them to be able to determine the microbial quality of commercial inoculants. The program was run as series of lectures/tutorials in the morning followed by hands on laboratory activities in the afternoon. This ensured the theoretical basis exists for all participants prior to learning the hands on skills.

The program was as follows (Monday 21 April to Friday 25 April):

Monday AM

- Opening Ceremony
- LDD biofertilizer activities

Monday AM

Theory:

- What are Biofertilizers?
- Biofertilizer Quality Control

Tuesday AM

Theory:

- Structure and Function of Bacteria
- Bacterial Growth and Division, Bacterial growth media
- Classification of Bacteria

Tuesday PM

Lab: Isolation and purification of bacteria, microscopy, enumerating bacterial numbers in products

1. Aseptic transfer of bacteria: from liquid culture to liquid culture, from plate to liquid culture (follow up Wednesday – observe culture)
2. Streaking for single colonies (follow up Wednesday – observe plates for single colonies)
3. Gram Stain technique and observation under microscope
4. Observation of live Bacteria under microscope

Wednesday AM

Theory:

- Plant Microbe interactions, plant growth promoting bacteria –
- Presentation of results from field trials

	Wednesday PM Lab: Preparing solid and liquid growth media, autoclaving Glasshouse demonstration trials to asses plant growth promoting bacteria 1. Preparing solid and liquid media – make up small batches of both, autoclave, pour plates 2. During autoclave waiting time: dilution of a soil/inoculant sample, spread plate to isolate single colonies 3. Observation of plates and cultures from Tuesday **4.** Bacterial morphology – view slides of gram positive rods and coccus, become familiar with bacterial morphology **Thursday AM** Theory: • Introduction on molecular biology and techniques to identify the strains contained in the products **Thursday PM** Lab: preparing cultures for PCR, DNA extraction 1. DNA extraction from a liquid culture 2. Single colony PCR 3. Preparing for 16S rRNA PCR, making master mix, setting up PCR reaction **Friday AM** • Sequencing and other techniques (fingerprinting), ID of bacteria (BLAST search) **Friday PM** Lab: Visualizing PCR products, interpreting results 1. Prepare gel, load and run samples 2. Visualise Gel, interpret results

THE CRAWFORD FUND

4	**Please state how the expected outcomes (see application) have been achieved**
	This course achieved the following outcomes: Train participants to: 1. Isolate, purify and characterise bacteria using standard and robust methodologies from existing inoculant products with the objective to assess their microbial quality 2. Identify to genus level target bacteria using basic molecular biology techniques such as PCR (polymerase chain reaction) fingerprinting, and preparing bacterial DNA for sequencing. This aspect is crucial as claims of efficacy made by manufacturers depend on the inocula actually containing the claimed microorganisms with the objective to identify the microorganisms contained in the commercial products. It also provided a detailed handbook of methods relevant for assessment of microbial products.
5	**Participant's feedback (**Please provide information on the outcomes of the course from the participants point of view and the likelihood of application of skills, including learning in the workplace and transfer of skills, including barriers such as lack of equipment or research facilities**)**
	Please see attached feedback forms
6	**Summary** Please provide an account of the training (250-300 words) suitable for the basis of an item to be included in The Crawford Fund newsletter "Highlights" or as a press release. If available please attach photographs relating to the training.

	The high costs of nitrogenous fertilizers, phosphate and other agricultural inputs (particularly in developing countries) is driving the development and use of beneficial microbes to enhance crop production. Microbial products represent a relatively cheap alternative to the fertilizers, and have been shown to perform very well in different kinds of environments (including different crop types and different soil types). However, there is little information on the actual content of these products and the regulation to control their quality is globally poor. This means that an increasing number of products are being sold in SE Asian countries most of which have not been certified to be pure cultures (or to have a controlled level of contaminants), have not been assessed for efficacy or their potential to be human pathogens. Producers are purchasing these products without any systems being in place to ensure quality control. The aim of this training class was to train scientists to be able to assessing the microbial quality of commercial inoculants and to distinguish ineffective products from quality inocula in their national markets and thus allow promotion of only the effective ones. To allow SE Asian farmers to benefit from these new products, systems need to be in place to ensure only effective inocula are sold. Ultimately, the aim of this training class was to train scientists to assess the microbial quality of commercial inoculants and to distinguish ineffective products from quality inocula in their national markets and thus allow promotion of only the effective ones.
7	**Do you have any general comments you would like to share with the Crawford Fund?**

4) On-the-job training ECOFILTER

16 to 20 June 2014

- Objective
  Provide new scientific knowledge on the filtration of overland flow ("grey water") by soil and the vegetation along hill slopes and the riparian zone in tropical agro-ecosystems
  Train national colleagues from Thailand, Laos and Vietnam on the research methodologies implemented during the project and their interpretation (i.e. water flows and water quality measurements)

- List of Participants

	First Name	Last Name	Country	Institute
Trainees				
Mrs	Pem	LUANGSAKDA	Lao PDR	NUoL
Mr	Oloth	SENGTAHEUANGHOUNG	Lao PDR	DALaM
Mr	Nikom	HMAIMUM	Thailande	DNP
Mrs	Navarat	KAMANEE	Thailande	DNP
Mr	Hai	TRAN SY	Vietnam	SFRI
Mr	Rinh	PHAM DINH	Vietnam	SFRI
Assistants in Lak Sip				
Mr.	Keooudone	LATSACHACK	Lao PDR	IRD-Vientiane
Mr.	Bounsamay	SOULILEUTH	Lao PDR	IRD-Vientiane
Mr.	Phabvilay	SOUNYAFONG	Lao PDR	IRD-Vientiane
Mr.	Chanthanousone	TAMMAHAKSA	Lao PDR	IRD-Vientiane
Trainers				
Mr.	Olivier	RIBOLZI	France	IRD-Toulouse
Mr.	Norbert	SILVERA	France	IRD-Vientiane
Mrs	Emma	ROCHELLE NEWALL	France	IRD-Paris
Mr.	Henri	ROBAIN	France	IRD-Bangkok
Mr.	Alain	PIERRET	France	IRD-Vientiane
Mr.	Corentin	CLEMENT	France	IRD-Vientiane
Mr	Christian	VALENTIN	France	IRD-Paris

- Main output

Capacity building of trainees during three main working sessions that included field/laboratory measurements and their interpretation: (1) Workshop « runoff versus infiltration at plot scale along hill slope » (Field work, 1m2 plots and Gerlach plots runoff measurements and surface description, office work Calculations and interpretations); (2) Workshop « Water quality » (Field and Lab work Physico-chemical measurements and E coli analysis, Lab work Alcalinity measurement by GRAN titration; Calculations and interpretations); (3) Workshop « run-off versus infiltration at sub-catchment scale » (Field work Discharge measurements, Pumping tests, Office work Hydrogram separation methods, Calculations and interpretations).

Joint French-South-East Asia Research and Training initiative

DYNAMIC OF LAND USE CHANGES AND SOIL ECOSYSTEM SERVICES (LUSES)

Report on a the collective training "How to monitor Soil Biodiversity" 3 to 14th of November 2014



Title: Soil biodiversity and activity: from sampling to data analysis

Organization committee:
Kanika Sajjaphan, Associate Professor at Kassetsart University
Pusanisa Heepngoe, PhD student at KU
Monrawee Peerawat, Researcher at LDD Dept Biotech, PhD student at KU
Alain Brauman, IRD, LDD
Savitree Sriratampai, LDD-TICA, assistant of LMI LUSES
Pissamai Chantuma, CRCC DOA.

Date : 3st to the 13th of November 2014

Participants: 14

No.	Name	Surname	Institutions	Country	Email Address
1	Naunjan	Pasda	LDD Biotech	Thailand	nuanjun24@hotmail.com
2	Monrawee	Peerawat	LDD Biotech	Thailand	monraweepeerawat@gmail.com
3	Panthip	Panklang	LDD region 11	Thailand	nan_phantip@hotmail.com
4	Sukanya	Taweekit	LDD region 5	Thailand	spromsakha@yahoo.com
5	Pusanisa	Heepngoen	KU	Thailand	kero_peach@yahoo.com
6	Pisamai	Chantuma	CRCC	Thailand	pisamai41@hotmail.co.th
7	Warurilne	Kamla	CRCC	Thailand	-
8	Napaporn	Mona	CRCC	Thailand	-
9	Treenuch	Promnok	KKU	Thailand	som_treenuch@hotmail.com
10	Papatsara	Machaiyaphum	KKU	Thailand	papatsara.nat@gmail.com
11	Porntip	Puttaso	KKU	Thailand	nuchdy_p@hotmail.com
12	Pascal	Lienhard	DP Cansea	Lao	pascal.lienhard@cirad.fr
13	Soulikone	CHAIVANNA	Dalam	Lao	schaivanhna@yahoo.com
14	Nguyen	Thao Nhung	SFRI	Vietnam	thaonhung.nguyen@gmail.com

Trainers:

- Jean Trap (IRD, LMI LUSES, UMR ECO&SOLS)
- Alain Brauman (IRD, LMI LUSES, UMR ECO&SOLS)
- Thibaud Decaëns Prof. Univ. Montpellier (CEFE, UMR 5175 CNRS)

Localization:

- 3 to 6th of November: CRRC Rubber platform in Chachoengsao
- 10 to 13th of November: Kasetsart University, Dept of Soil.

LMI scientific project support: Tree plantation and soil

Budget description including identify amount budget from co -funding if it is available

Total budget 8165 €

	Budget required	Designation
KU	1000	Training facilities, scientific and basic molecular equipment ie. stereo microscope (10 to 12) PCR and two staff as resource persons as well as one post graduate students to join the course.
LMI LUSES	4564	Mission and accomodation of Thibaud Decaens, participation to lab expenses. accomodations for two vietnam sans Lao tudents.

IFC	2000	Mission and accomodation of jean Trap (from France), Trip and accomodations for two vietnam students.
CANSEA	600	Participation of Pascal Lienhard and one researcher from NAFRI

General and specific objective

General: Learn how to characterize the soil fauna biodiversity and activity (OM decomposition) in a perennial plantation

Specific

1. Design a soil fauna survey sampling (block design, intra and inter replicates)
2. Identify and characterize the soil macrofauna diversity at the order or family level
3. Characterize the impact of soil macrofauna on soil functioning (organic matter decomposition pattern) via the:
    a. Description of the humus layer of the soil (see humus index)
    b. The use of an indicator of soil functional activity (lamina bait technique)
4. Organize data (contingence table) and analyse them on excel (use of pivot table)
5. Give a first Initiation to multivariate analysis (Principal Component Analysis)

Specificity and originality of the training

The main purpose of this training was to initiate the participants to a research approach in soil ecology. For this purpose, we decided to:

- Link this soil survey to a defined research question (impact of plantation age on soil fauna community structure and activity)
- To undergo a "learning by doing" approaches
- To link data collection, data organization and statistic analyses in a same training.

Thus, the originality of this training lies on the continuous curriculum from field tasks (such as soil fauna sampling and humus form description) to laboratory tasks (fauna identification, litter weighting) and data exploitation using statistical analyses. This training provide important and central ecological tools for students in the analysis of land uses impacts on ecosystem services.

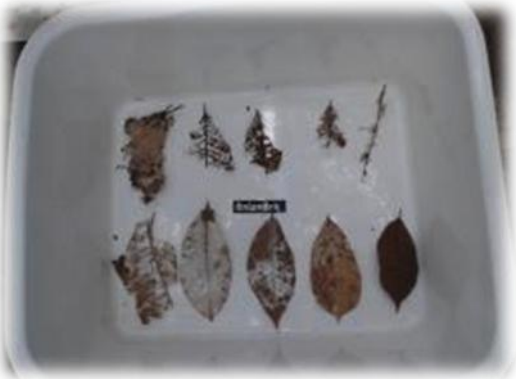
Context of the training: Why it's important to study soil fauna diversity and activity

Soil is one of the most diverse environment of earth (~25% of global biodiversity in terms of species), but also one of the least known concerning its biodiversity (less than ~ 10% of described species). From a functional point of view, soil organisms (including plants) provide crucial ecosystems functions that supply important ecosystem services. For instance, decomposers are responsible for chemical transformations of organic matter and nutrient cycling and macro-invertebrates (earthworms and arthropods) are able to alter, physically and permanently, the environment of others species. Bioturbation activities of earthworms have a major impact on the spatial structure of the soil, the incorporation of organic matter in the soil and microbial activity. ***Any changes in soil biodiversity, as induced by land use changes, may impact the whole functioning of the ecosystem**, **and in particular, its productivity, which is a central ecosystem service.***

Training schedule

- 2nd November: Arrival of the trainees in Bangkok
- 3rd November:
  Morning Transfer to Chachoengsao
  Afternoon: Lamina baits installation (protocol in appendix 2)

- 4 th to 6 th November: Data collection
  - macrofauna surveys (for protocol see appendix 3)



  - humus index, litter cover description (for protocol see appendix 4)

- 7th November: Data collection (macrofauna) in a national protected forest area and travel back to Bangkok
- 10th -11th November: Lamina baits and humus data analysis in KU
- 12th November: identification of soil macrofauna
- 13-14th of November: data analysis
    - 13th November: Data organization for statistics (contingency table, pivot table)
    - 14th November morning : multivariate analysis
    - 14th November end of morning : Open lecture by Prof Thibaud Decaens on "How to monitor soil fauna diversity using barcoding technology"

    - 14 November: common meal and end of the training

Main output

In terms of soil fauna survey and activities

- Setting up of an experimental design (block assay with intra and inter repetition)
- Setting up of a soil fauna survey (where to put the plot, number of plot repetitions)
- How to collect soil fauna using TSBF technique (see appendix 3)
- How to analyse the soil OM layer using the Humus index method (see appendix 4)
- To use lamina bets technology to monitor OM degradation (see appendix 2)

In terms of data analysis they know now

- How to organize data tables
- How to set a contingence table
- How to use excel and the pivot table to plot data, calculate means and standard deviations
- How to use (for some of them) Xlstat to do multivariate analysis

Evaluation comments and auto-analyse (appendix 1)

All the objectives and goals were achieve and we got a complete set of data, which can now be valorise (we schedule 2 papers). But the result of the evaluation (see appendix 1) shows that the training did not reach the level of expectations of some participants. For the next training session, we certainly need to:

(i) Be clearer about the objectives and agenda. As it was the first time we organized

such a training, it was not obvious to determine for each analysis the time required

(ii) To give the documents (methodological papers, protocols, lectures) in advance before the training

(iii) To develop further the activities devoted to data analyses and statistics

However, all the trainees at the end of the training got the following knowledge:

<u>In terms of sampling strategy in the field</u>

- What is an experimental design (block assay with intra and inter repetition).
- How to design a soil survey (where to put the plot, number of plot repetition).
- How to collect soil fauna using TSBF technique.
- How to analyse the soil OM layer using the Humus index method.
- How to use lamina bets technology to monitor OM degradation.

<u>In terms of data analysis</u>

- How to organize their data,
- To set a contingence table,
- To use excel and the pivot table to plot their data, calculate mean and standard deviation,
- To use (for some of them) a statistical software to do multivariate analysis

Auto-analysis: the strength and assess of the learning by doing approach

For some of the candidates, this "learning by doing" approach was new, as most of the trainees are used to a more classical approach (first theory with lectures and secondly field demonstration). The learning by doing approach is more related to the real life of a researcher; *theory must originate from questions arising from field works.* We do not want demonstration on a blackboard, we want each student to get is own data, acquired the skill to analysed it and to ask questions related to is field works to the trainers. This was our goal, and this training was successful in that term.

Appendix J: Report of Workshop on Sustainability of Natural Rubber

Workshop on Sustainability of Natural Rubber in the 21st Century

Current status and future Outlook

October 15th to 18th 2014 - Vientiane, Laos

The workshop on Sustainability of Natural Rubber in the 21st Century – Current status and future Outlook, took place in Vientiane, Laos from October 15th to 18th, 2014.

This workshop (WS) was hosted by the National University of Laos (NUoL) and the Department of Agricultural Land Development (DALAM) from the Laos Ministry of Agriculture and Forest. Around 90 participants participated to this event, who originated mainly from Asian countries (Lao, Thailand and China) but also from developed countries, such as France, Germany, and the USA. The WS was co-organized and funded by several projects linked to research on rubber plantations in SEA such as the French Institute of Research For Development (IRD, via two main partnerships tools the PPR SELTAR (http://irdseltar.wordpress.com) the LMI LUSES project (www.luses/ird.fr), the Hevea Research Platform in Partnership (http://hrpp.ku.ac.th), the Project on "Sustainable Rubber Cultivation in the Mekong Region – SURUMER" (https://surumer.uni-hohenheim.de) and the Green Rubber Project (GRP, World Agroforestry Centre (ICRAF), GIZ project #13.1432.7-001.00).

Natural rubber plantations play an important role in Southeast Asia as an economic, social and politic contributor. Rubber plantations also have a large effect on the environment, including soil and water sustainability and biodiversity. These impacts need to be addressed and evaluated at a regional scale, which constitutes the aim of this event. The other goals of this WS were to initiate a connection between the main projects working on this theme in the Greater Mekong Subregion (GMS), define state of the art of research on sustainability of natural rubber production in the GMS and identify options for future collaborative research and potential interventions.

The first day of this four day workshop started with an official welcome ceremony. The welcome address was conducted by representatives of the hosting institutions, including NUoL and NAFRI. It was followed by an informative keynote presentation by Professor Silinthone (NUoL) on socio economic aspects of Lao agriculture with a special emphasis on rubber plantation.

The second day started with short presentations of the rubber research initiatives in the Mekong region (SURUMER, GREEN RUBBER) together with a presentation of the different partnerships tools of IRD (LMI LUSES AND PPR SELTAR) and CIRAD (HRPP). The rest of the day was devoted to two main thematic (i) water and carbon dynamics in rubber landscapes, introduced with a keynote presentation by F. Gay from CIRAD on CO2 fluxes and net primary production, and (ii) rubber management and soil biological functioning, introduced with a keynote presentation by A. Brauman from IRD on the impact of agricultural practices on soil biodiversity.

The third day was dedicated to two further plenary sessions; (i) modeling the impact of climate change and land management on latex yield, livelihoods and ecosystem services, introduced with a keynote presentation by Rhett Harrison (GRP) from ICRAF on rubber impacts on ecosystems and ecosystem processes, and (ii) socio-economic impacts and stakeholders, which was the longest session of the meeting with 13 presentations. This session was introduced with a keynote presentation from Professor J.M. FOX from University of Hawaii, who gave an overview of the expansion of rubber in mainland Southeast Asia.

The last day consisted of a group meeting comprising 25 representatives from participating rubber research projects and institutions dedicated to the development of proposals. This resulted in three proposals which will be submitted to different funding agencies (EU, ABD etc...).

In summary, this WS considerably exceeded the expectations of the organizers. All the participants noticed the high scientific level of the presentations and the potential of synergies between the different projects involved at the GMS scale. This WS will contribute in the near future to the development of future collaborative research that will better define more sustainable rubber management options in this GMS area.

As an immediate action, the organizing institutions agreed to set up an exchange platform covering ongoing research activities on rubber in mainland SE Asia. This platform will promote scientific exchange at a regional level, enable scaling up of interventions through the participating national level extension agencies, and coordinate the release of policy briefs at a regional level. In addition, it is hoped that the platform can provide opportunities for training and capacity development.

Agenda

Wednesday, October 15

12:00 - 15.00: Registration at Lao Plaza Hotel

15.00 - 16.00: Opening of Rubber-WS

- Welcome by MC Dr. Lampheuy Kaensombath and Savitree Sriratampai (NUOL and LDD-IRD)
- Welcome address of Assoc. Prof. Dr. Silinthone Sacklokham
- Presenting objectives of WS (member of the organizing institutions)
- Official opening by the president of NUOL and Director of NAFRI (or its representant)

16.00-16.45: Key Note lecture of Assoc. Prof. Dr. Silinthone Sacklokham

17.00 - 18.30: Welcome Cocktail at Lao Plaza Hotel

Thursday, October 16

08:30 INTRO-SESSION: Rubber Research Initiatives in the Mekong Region (20min.)

1. SURUMER-Sustainable Rubber Cultivation in the Mekong Region. G. Cadisch & G. Langenberger (University of Hohenheim, Germany)

2. Green Rubber- An integrated system approach for agricultural intensification and conservation in the Mekong Region. J. Xu & R. Harrisson (KIB/ICRAF Kunming, China)

3. The LMI LUSES- A regional project in partnership on the impact of Land uses on Soil Ecosystem services. A. Brauman (IRD, UMR ECO&SOLS, Thailand) and N.Suvannang (LDD, Thailand)

4. The Hevea Research Platform in Partnership in Thailand (HRPP) - Challenges of Natural Rubber Production, Developmental Issues & Questions to Research. P. Thaler (CIRAD, HRPP, Thailand)

5. PPR SELTAR - A Regional Priority Program on soil, water & littoral in Southeast Asia. C. Valentin (IRD, UMR IESS, France)

10:10 Coffee Break

10:30: SESSION 1: WATER AND C- DYNAMICS IN RUBBER LANDSCAPES

Chairman: Thaler Philippe (CIRAD) and Pheng Sengxua (DALAM)

Introductary lecture (15+5)

Gay, Frédéric (CIRAD, HRPP) and Chompunut, Chayawat (KU, HRPP): CO_2 fluxes and net primary production (NPP) of rubber plantations

<u>Invited speakers</u> (15+5)

1. YANG, Xueqing: Carbon storage potential of rubber plantations of different age and elevation in Xishuangbanna (SURUMER)

2. LANG, Rong: Respiration in rubber plantation and rainforest indicate different processes during the rainy season (SURUMER)

3. LIU, Hongxi: Effect of water erosion and land management on the soil carbon stock of intensive rubber plantation in Xishuangbanna (SURUMER)

4. PANSAK, Wanwisa: The effects of converting Hillside Cropping Systems to Hillside Rubber (*Hevea brasiliensis*) Plantation on Erosion in Northern Thailand (Naresuan University)

12:10 Lunch

13:30: SESSION 1: WATER AND C- DYNAMICS IN RUBBER LANDSCAPES (cont.)

5. ROBAIN, Henry: Is it important to study soil variability to address the eco-system services of rubber tree plantations? (IRD/LUSES)

6. DO, Frédéric & Isarangkool Supat: Water use typology in rubber tree genotypes and consequence on C dynamics and sustainability. (IRD/Khon Kaen University/ HRPP)

7. PIERRET, Alain: Deep rooting patterns of rubber trees: results from a regional survey along a pedo-climatic gradient in Southeast Asia (IRD/LUSES)

14:30 Coffee Break

15:00: SESSION 2: RUBBER MANAGEMENT AND SOIL BIOLOGICAL FUNCTIONNING

Chairman: BRAUMAN Alain (IRD)

Introductary lecture (15+5)

BRAUMAN, Alain: Impact of Agricultural Practices on Soil Biological Functioning in Rubber Plantations

<u>Invited speakers</u> (15+5)

1. PEERAWAT, Monrawee: Rubber tree impact on soil functional biodiversity, a case study in Chachaengsao in Thailand (IRD/LUSES)

2. SHI Ling Ling, Peter Mortimer and Jutamart Monkai: Impact of Hevea brasiliensis on soil fungal diversity (ICRAF)

16:00 Coffee Break

3. SUVANNANG, Nopmanee: Introducing a legume cover crop in hevea plantations - a way to achieve sustainability of rubber plantations in marginal areas?

4. GOLDBERG, Stephanie: Measurement of rubber impacts on Green House Gas emissions

17:05 End of Day 1

Friday, October 17

08:00: SESSION 3: MODELLING IMPACT OF CLIMATE CHANGE & LAND-MANAGEMENT ON YIELD, WELFARE AND ECOSYSTEM SERVICES (ESS)

Chairman: Georg Cadisch (University of Hohenheim) and Jianchu XU (KIB/ICRAF)

Introductory lecture (15+5)

Harrison, Rhett: Review of rubber impacts on ecosystems and ecosystem processes (ICRAF)

Invited speakers (15+5)

1. LACOTE, Régis and Chantuma, Pisamai: Physiological bases of latex production and tapping management. Consequences for adaptation to climate change. (CIRAD/RRIT/HRPP)

2. THALER, Philippe: Specific issues to model rubber tree functioning and latex yield. (CIRAD/HRPP)

3. SOPHARAT Jessada, & DO, Frédéric : Lessons from the use of a simple model to simulate transpiration of rubber trees along a climatic gradient (PSU/IRD/HRPP)

09:20 Coffee Break

4. BLAGODATSKY, Sergey: Simulation of rubber development and latex production with the model LUCIA (Land Use Change Impact Assessment) (SURUMER)

5. HAMMECKER, Claude & Siltecho, Siwaporn: Modeling Soil water dynamics in Rubber Tree plantation (IRD/LUSES)

6. WIESEHAHN, Jens: Improved mapping of rubber (Univ. of Göttingen)

10:20 Coffee Break

10:35: SESSION 4: SOCIO-ECONOMY AND STAKEHOLDERS

Chairman: Assoc. Prof. Dr. Silinthone Sacklokham (NUOL) and Fox J.M (East-West Centre Hawai'i)

Introductary lecture (15+5)

FOX J.M. & CASTELLA J.C.: Expansion of rubber (*Hevea brasiliensis*) in Mainland Southeast Asia: What are the prospects for smallholders?

Invited speakers (15+5)

1. KEOKHAMSAO Phoukeo. Adapted livelihood strategies of smalscale rubber plantations in Luang Nam Tha Province, Lao PDR.

2. WAIBEL, Hermann (with Min, Shi and Jikun, Huang):Long term income risks for small scale rubber farmers in Xishuangbanna, China (SURUMER)

3. ANGTONG, Suthipong. The Rubber replanting aid fund in Thailand (ORRAF).

4. CHAMBON, Bénédicte: Diversity of rubber farms in Thailand.

12:15 Lunch

13:30: SESSION 4: SOCIO-ECONOMY AND STAKEHOLDERS (cont.)

5. LANGENBERGER, Gerhard: Rubber intercropping – trends and perspectives (SURUMER)

6. JONGRUNGROTE, Vichote. Agroforestry sytems and farm viability in southern Thailand

7. THALER, Philippe. The Sustanaible Rubber Initiative (SNRi) of the International Rubber Study Group (IRSG).

8. WANG, Jue and AENIS, Thomas: Stakeholder analysis in sustainable regional development project: Experience from rubber cultivation in SW China (SURUMER)

9. CANET, Mélanie: The rubber value chain and its challenges in Luang Namtha Province (GIZ Laos)

15:10 Coffee Break

10. SOPHEAVEASNA, Mak. Issues of rubber development in Cambodia. Qestions for research (CRRI).

11. FLIT MERTENS, Charlotte; SCHMIDT-VOGT, Dietrich: Differentiated access to forest resources in rubber dominated landscapes (ICRAF)

12. NGUYEN, Quyen: The GMS Core Environmental Program – Contributions to sound environmental management (ADB)

13. ANGULO, Rafael: *Newsoil, a project t be submitted to the H2020 call for proposal of the EU*. (CNRS, France).

16:45: DISCUSSION AND CONCLUSIONS

- Synthesis of major findings: "The future of NR in the 21st century"

18:00: Closure ceremony

Saturday, October 18 (internal organizer meeting)

Writing of a pre-proposal (invited participants only).

Participants List

No	First name	Family name	Institute
1	Alain	Pierret	IRD
2	Alain	Brauman	IRD
3	Amphai	Darasouk	NUOL
4	Anousone	Saiyalatn	NOUL
5	Beedou	APHAISO	NOUL
6	Benedicte	Chambon	CIRAD
7	Chanthasone	Khamxaykhay	DALAM
8	Charlotte	Flit Mertens	ICRAF
9	Chitpasong	Kousonsavath	NUOL
10	Chompunut	Chayawat	KU
11	Chris	Flint	TABI
12	Christian	Valentin	IRD
13	Christian	Hartmann	IRD
14	Chua	Kating	ICRAF
15	Claude	Hammecker	IRD
16	Coroline	Savin	IRD
17	Didier	Orange	IRD
18	Dietrich	Schmidt-Vogt	ICRAF
19	Francois	Guegan	WWF
20	Frank	Enjalric	CIRAD
21	Frederic	Gay	CIRAD
22	Frederic	Do	IRD
23	Georg	Cadisch	SURUMER
24	Gerhard	Langenberger	Surumer
25	Henri	Robain	IRD
26	Hongxi	Liu	Surumer
27	Jate	Sathornkich	KU
28	Jean-Christophe	Castella	CIRAD
29	Jean-Louis	Janeau	IRD
30	Jeff	Fox	EWCH
31	Jemxay	Tangseksanh	TABI
32	Jens	Wiesehahn	Univ of Gottingen
33	Jens	Wiesehahn	Univertsity Goettingen
34	Jessada	Pattaralerpung	KU
35	Jessada	Sopharat	KU
36	Jiading	Zhou	Beijing Uni
37	Khamchane	Singmixay	NUOL
38	Khamla	sengphaxaiyalath	NAFRI

Participants List

No	First name	Family name	Institute
39	Khomluang	Keoke	Leaning Facility
40	Kridtiyaporn	Wongsa	CMU
41	Kumut	Sangkahasila	KU
42	Lampheuy	Kaensombath	NUOL
43	Lang	Rong	Surumer
44	Latsany	Phakdisoth	Leaning Facility
45	Lingling	Shi	ICRAF
46	Mai	Maithaphone	NOUL
47	Mak	Sopheaveasna	CRRI
48	Maliphone	Douangphachank	NUOL
49	Manisorn	Ananta	RRIT-DOA
50	Melanie	Canet	GIZ
51	Michel	Grimaldi	IRD
52	Monrawee	Peerawat	LDD
53	Natta	Takrattanasaran	LDD
54	Nattavadee	Sudchalieo	LDD
55	Nguyen	Quyen	ADB
56	Nopmanee	Suvannang	LDD
57	Oliver	Schoenweger	CDE
58	Olivier	Girard	AFD
59	Oloth	Sengtah	DALAM
60	Ornuma	Duangngam	KU
61	Pascal	Lienhard	CIRAD
62	Peter	Asmussen	GIZ
63	Pheng	Sengxua	DALAM
64	Philippe	Girard	CIRAD
65	Philippe	Thaler	CIRAD
66	Phimasone	Sisouvanh	NUOL
67	Phonethip	Banouvong	iwmi
68	Phonththasone	Sibounnavong	NUOL
69	Phoukeo	Saokhamkeo	FOA, NUOL
70	Pissamai	Chantuma	RRIT-DOA
71	Pusanisa	Heepngoen	KU
72	Raphael	Angulo	CNRP
73	Regis	Lacote	CIRAD
74	Rhett D.	Harrison	ICRAF
75	Rob	Cole	CIFOR
76	Savitree	Sriratampai	LDD-IRD
77	Saythong	Vilayvong	NUOL
78	Sergey	Blagadalsky	Surumer
79	Silinthone	Sacklokham	NUOL
80	Sisavath	Phimmasone	Dalam

Participants List

No	First name	Family name	Institute
81	**Somvang**	**Phimmavong**	**NUOL**
82	Sounthone	Phommasone	NUOL
83	Stephanie	Goldberg	ICRAF
84	Suttipong	Angthong	ORRAF
85	Thipphasone	Luangaphay	VFI
86	Tian	Yaohua	Yunan inst of tropical
87	Vichot	Jongrungrot	KU
88	Vichote	Jongrungrote	KU
89	Vong	Nanhthavong	CDE
90	Waibel	Hermann	Surumer
91	Wang	Jue	Surumer
92	Wanwisa	Punsak	Univ. Naresuan
93	Xueqing	Yang	Surumer

Appendix K:

SEALNET network

1. Report of SEALNET Network project
2. Report of missions

1. Report of SEALNET Network

TITLE

South-East Asia Laboratory NETwork (SEALNET) (phase II)

LEADERS: ASIAN AND FRENCH

- Nopmanee Suvannang, Director of Soil analysis Technical Group, Office of Science for Land Development, Land Development Department (LDD), Bangkok, Thailand
- Jean-Louis Duprey, Institut de Recherche pour le Développement (IRD) – US IMAGO, In dian Institute of Science, Bengalore, India
- Christian Hartmann, Institut de Recherche pour le Développement (IRD) (UMR242 iEES-Paris) – Department of Agricultural Land Development (DALAM) Vientiane, Lao PDR
- Didier Orange, Institut de Recherche pour le Développement (IRD) (UMR242 iEES-P aris), Soils and Fertilizers research Institute (SFRI), Hanoi, Vietnam

LMI PARTNERS

- ASIAN
  - **LAO PDR**: DALAM (Department of Agricultural Land Development)
    - Dr. **Pheng Sengxua** kham (Director of ALUPC), **Oloth Sengtaheuanghoung** (De puty Director of ALUPC) **Xaysatith Souliyavongsa**, (Deputy head of laboratory section)
  - **THAILAND** : LDD (Land Development Department)
    - **LDD**: **Nopmanee Suvannang** (soil chemist); Kammarin Nimnuanra (soil scientis t); **Chiraporn Ninchawee** (Soil Scientist)
  - **VIETNAM**: SFRI (Soils and Fertilisers Research Institute) and ICH (Institute of C hemistry of Hanoi)
    - **SFRI** :**Tran Minh Tien** (Deputy Director of SFRI), **Do Duy Phai** (Head of C entral Laboratory for Soils, Plants and Fertilizers)
    - **ICH : Vu Duc Loi** (Deputy Director of ICH), **Luu Thi Nguyet Minh** (Resear cher in Environmental Chemistry)**, Duong Tuan Hug** (Researcher in Environ mental Chemistry), **Le Thi Phuong Quyen** (Head of laboratory of Environme nt Biogeochemistry, INPC)

OTHERS PARTNERS

- Agriculture Research Center (ARC), NaPok, Vientiane province, LaoPDR

SCIENTIFIC PROJECT

Short context

To implement the soil quality control in order to test their performance through inter-laboratory sampe exchanges and a statistical evaluation of the analytical data

Objective

1. the evaluation of strengths and weaknesses in the organisation and management of the soil/plant/water laboratories involved in the LMI LUSES programme;
2. to establish inter calibrations, protocols standardisation, exchange of expertise, etc…

MAIN ACHIEVEMENT OF THE YEAR 2014

1. First survey of the laboratories capacity building.

From 20th to 29th April 2014, we visited all soil/plant/water laboratories involved in LMI LUSES programme and evaluated their strengths and weaknesses, we provided a first set of suggestions for standardisation and imporvement of their procedures.

Main observations on the laboratories we visited:

SFRI : They are preparing a soil reference sample to check all analysis of their labs with support from ACIAR funding, Australia. They are interested by an intercalibration with the other laboratories of the LMI and by trainings on soils and plants analysis.

ICH / INPC/ IET : ICH carry out research on the watershed management focusing on soil and water quality and modelling. While the laboratory of INPC is focused on the dissolved and particulate organic carbon analysis. The IET carries out researchs about nutrients in waters and biological quality of waters. However, They are interested by using water CRM to control and validate their analysis.

NAFRI: The DALAM laboratory for soil survey was renovated last year with the support from ACIAR (Australian Centre for International Agricultural Research. It seems that each person is using correct procedures to run the analysis he is responsible for. This laboratory includes internal reference soils in each batch as Quality Controls (QC) but nevertheless some criterias to accept or reject analytical results are not yet clearly established. They are interested by improving Quality by the way of intercalibrations, trainings for laboratory manager and technicians.

LDD: The management of laboratory for all the analytical process is clear. The maintenance of work spaces and equipments is efficient. Every serie of samples analysis is controled by use of internal reference samples. This lab is preparing certification ISO 17025 for its activities and needs some help for that. The use of soil and plant CRM and intercalibration with internal soil references of all the labs involved in LMI LUSES could help it to improve the quality of its analytical process

2. Interexchange soil samples.

Two soil samples from NAFRI, 1 soil sample from SFRI and 5 soil samples from LDD were interexchange for 5 paprameter, pH, EC 1:5, OM, avail P and avail K in NAFRI and LDD,. 2 soil samples from NAFRI were exchanged to SFRI The data still in processing for the statistic results

Remarks, as the soil samples from SFRI had low quatity, we can not send this sample to NAFRI as it is not enough to process.

3. Ordering the Certified reference samples

Two internal soil reference samples are processing to buy from the WAPAL, which is the high standard institution that can achieve the certified values of the internal soil reference samples.

4. Student exchange for international collaboration

Ms. Metinee, master student at khonkaen University as an internship to do the intercalibration of the soil samples from DALAM and LDD and also worked at NAPOK.

PERSPECTIVES 2015 :

Description	Cost (€)
Share our protocols and list of instruments/equipments in English version	0
Training for technical staff and managers (traveling, accomodation, *etc.*)	3 000
Organize an inter calibration with our internal references	0
Interexchange soil samples analysis and statistical analysis of the data	500
Work meeting to analyse CRM, share the results and detail future priorities	2 000
Share our labs capacities	
Total budget that need to be found for 2015	**5 500**

2. Report of SEALNET network missions

Report of the mission to Vietnam, Thailand and Laos carried out by Nopmanee SUVANNANG and Jean-LouisDUPREY from 20th to 29th April 2014

Objective

The main issue of this mission is the evaluation of strengths and weakness for the soils/plants/waters labs involved in the LMI LUSES and the study of possibility to create a network with the aim of establishing inter calibrations, exchange of expertise, protocols, etc…

Schedule

Sunday 20 April 2014:

9 :35 Arrival at Noibai Airport, Hanoï

Monday 21 April 2014:

9:00 – 11:30 Welcome by Didier Orange at the hotel
Visit of SFRI (Soil and Fertilizers Research Institute)
with Tran Duc Toan, Do Duy Phai, Tran Minh Tien and Didier Orange

11:30 – 13.:00 Lunch Break

13:30 – 15:00 Discussion at SFRI

15:30 – 16:00 Visit of IRD representation and discussion with Jean-Pascal Torreton

Tuesday 22 April 2014:

8:30 – 11:30 Visit of ICH (Institute of Chemistry Hanoï) and meetings with:
Vu Duc Loi, deputy director, Luu Thi Nguyet Minh and Duong Tuan Hung, researchers

11:30 – 13.:00 Lunch Break

13:30 – 16:00 Visit of IET (Instiute of Environment and Technology)

16:00 – 16:30 Discussion with Didier Lecomte, directeur scientifique de l'USTH (Université des Sciences et des Technologies de Hanoï)

17:45 Departure to Noibai Airport by taxi, Take off at 20h45, to Bangkok

Wednesday 23 April to Friday 25 April 2014

9:00 – 16:30 Visit of LDD laboratories and discussions with Mrs. Nopmanee Suvannang and some technicians of her team

Sunday 27 April 2014

21:45 Arrival at Vientiane airport and welcome by Christian Hartman

Monday 28 April 2014

9:00 – 11:00 Visit of NAFRI laboratory by Xaysatith Souliyavongsa

11:00 – 12.:00 Meeting with Pheng Sengxua, director of ALUPC (Agricultural Land Use Planning Center)

14:00 – 16:30 Discussion with Xaysatith, Nopmanee and Christian about laboratory practices and details on some protocols

Tuesday 29 April 2014

9:40 – 11:00 Discussion with Phou Thon in charge of the use of soil analysis results for soil survey classification

11:00– 12:00 Meeting with Oloth Sengtaheuanghoung, deputy director of ALUPC

14:30 – 15:00 Discussion with Metinee, bachelor student of Khon Kaen University (Thaïland) about her study project on results comparison of different labs under LMI LUSES

15:15 – 16:00 Debriefing with Nopmanee and Christian

18:30 Take off to Bangkok and Bangalore

Discussions at SFRI (Soil and Fertilizers Research Institute), Hanoï, Vietnam

With participation of

Tran Duc Toan	deputy director of Science and International Cooperation Management	SFRI
Tran Minh Tien	head Department of Soil Genesis and Classification	SFRI
Do Duy Phai	head of Central Laboratory for Soils, Plants and Fertilizers	SFRI

Nopmanee Suvannang	director of the Soils Analyisis Technical Service	LDD
Didier Orange	IRD scientist	UMR242 iEES-Paris
Jean-Louis Duprey	IRD engineer	US IMAGO

SFRI is a public science unit belonging to Vietnam Academy of Agricultural Sciences (VAAS). It was created on 6th March 1969 and has functions on scientific research, technology transfer, producing and trading in the areas of soil, fertilizer and microbiology on the whole Vietnam. SFRI has 4 centers in 4 regions of Vietnam.
SFRI in Hanoï has 3 main laboratories for soils survey and soils/plants/fertilizers, soils land use planning. They analyse all the basic soil parameters (pH water/KCl, texture, EC, total carbon, total and available nitrogen, total and available phosphorus, total and exchangeable potassium, acidity, total iron). Labs equipments are mainly: pHmeter, conductivimeter, atomic absorption spectrophotometer by flame, emission spectrophotometer, UV/VIS spectrophotometer, etc…

They are preparing a soil reference sample to check all analysis of their labs with support from ACIAR funding, Australia. They are interested by an intercalibration with the other laboratories of the LMI and by trainings on soils and plants analysis.

Discussions at Institute of Chemistry, Hanoï, Vietnam

With participation of

Vu Duc Loi	deputy director of Institute of Chemistry	ICH
Luu Thi Nguyet Minh	researcher in Environmental Biogeochemistry	ICH
Duong Tuan Hung	researcher in Environmental Biogeochemistry	ICH
Nopmanee Suvannang	director of the Soils Analyisis Technical Service	LDD
Didier Orange	IRD scientist	UMR242 iEES-Paris
Jean-Louis Duprey	IRD engineer	US IMAGO

Institute of Chemistry belongs to Vietnam Academy of Science and Technology. It carries out targeted fundamental research towards problems that are important for Vietnam in different areas of chemistry such as organic chemistry, natural product chemistry, polymer chemistry, inorganic chemistry, adsorption - catalysis, analytical chemistry, theoretical chemistry, electro-chemistry, bio-chemistry, environmental chemistry and chemical engineering.

The Laboratory of Environmental Chemistry of this institute carries out researchs to study and establish technological processes for treatment of organic, inorganic pollutants and toxic heavy metals existing in wastewater and drinking water. They also carry out research on the watershed management focus on soil and water quality and modelling. It is well equiped with ICP-OES, atomic absorption spectrophotometer, UV/VIS spectrophotometer, FT-ICR Mass Spectrometer, Nuclear magnetic resonance spectrometer, HPLC.

The topic of Luu Thi Nguyet Minh and Duong Tuan Hung's investigations is to follow the dynamic of nitrogen during its cycle in water and sediments. Parameters analysed are NO_3, NO_2, NH_4, total N, PO_4 . They are interested by using water CRM to control and validate their analysis.

Discussions at LDD (Land Development Department), Bangkok, Thaïland

With participation of

Nopmanee Suvannang	director of the Soils Analyisis Technical Service	LDD
Kammarin Nimnuanrat	Soil scientist	LDD
Chiraporn Ninchawee	Soil scientist	LDD
Jean-Louis Duprey	IRD engineer	US IMAGO

Land Development Department is a public organization created in 1963 which depend of the Ministry of Agriculture and Cooperatives. Its missions are:

- to conduct research, implement activities, provide services and transfer technologies on land development, including the establishment of land use zoning to enhance agricultural productivity, and the provision of accurate and updated spatial data.
- to develop basic infrastructure on land development, soil improvement and soil rehabilitation to increase agricultural productivity and sustainable land use
- to strengthen volunteer "soil doctors", farmers and farmers groups by providing knowledge on land development as a basis for sustaining livelihoods according to the principles of the "sufficiency economy"

LDD has about 2000 staff and consists of 28 major divisions. "Soil doctors" have been established since 1995 in order to increase the efficiency of the LDD activities. They are in charge of coordinating land development among farmers in their village and participating in some activities of LDD. There are more than 70 000 soils doctors all over the country.

The laboratory of Soil Analysis Technical Service is one of LDD laboratories situated in Chatuchak, Bangkok. It analyses about 10 000 samples by year with a team of 11 people (4 soil scientists, 3 technicians, 1 permanent assistant, 1 temporary assistant, 1 secretary, 1 labour for washing glassware). Samples come from farmers or research projects (parameters: pH, EC, organic matter, P, K, Ca, Mg, Na, CEC, texture). Main equipments are pH meter, conductivy meter, UV/VIS spectrometer, auto titrator, flame emission photometer and atomic absorption spectrophotometer.

LDD laboratory of Soil Analysis Technical Service is the most organised of the labs involved in the LMI LUSES. The management of all the analytical process is clear. The maintenance of work spaces and equipments is efficient. Every serie of samples analysis is controled by use of internal reference samples. This lab is preparing certification ISO 17025 for its activities and needs some help for that. The use of soil and plant CRM and intercalibration with internal soil references of all the labs involved in LMI LUSES could help it to improve the quality of its analytical process.

Discussions at NAFRI (National Agriculture and Forestry Research Institute), Vientiane, Laos

With participation of

Oloth Sengtaheuanghoung	deputy director of ALUPC	DALAM
Pheng Sengxua	director of ALUPC	DALAM
Xaysatith Souliyavongsa	deputy head of lab	DALAM
Christian Hartman	IRD Scientist	UMR242 iEES-Paris
Nopmanee Suvannang	director of the Soils Analyisis Technical Service	LDD
Jean-Louis Duprey	IRD engineer	US IMAGO

NAFRI is a public organization belonging to the Ministry of Agriculture and Forestry and is mandated to undertake integrated agriculture, forestry and fisheries research in order to provide technical information, norms and results which help to formulate strategy in accordance with the government policies. NAFRI has four main functions including: carrying out adaptive research, developing methods, tools and information packages, providing policy feedback, and coordinating and managing research.

The NAFRI lab for soil survey was renovated last year thanks to ACIAR (Australian Centre for International Agricultural Research). It employs 12 permanent agents and analyses about 1000 soil samples by year. It carries out all the basic soil analysis: pH, total carbon, total and available N P K, exchangeable cations, cations exchangeable capacity. Its main equipments are: pH meter, UV/VIS spectrophotometer, flame photometer, flame atomic absorption spectrophotometer.

This lab uses internal soil reference as Quality Control to control analysis but some criterias for validation of analytical series seem to miss. The chemicals stocks are in order but the safety could be improved by repairing air exhausters. The head of the lab and the director of department are interested by improving Quality by the way of intercalibrations, trainings for lab manager and technicians.

Conclusions

This short visit in the differents labs involved in the LMI LUSES was very interesting and we thanks a lot all the participants for the interest showed to this mission and for their warm welcome.

Some features of these labs are very differents like organisation, analytical equipments or hardwares, system of Quality Control, protocols etc…but the main goal of each lab is to provide the best quality for analytical datas with the best efficiency to its customers whether they are farmers or researchers. Even if protocols, equipments, analytical hardwares are differents, the results have to be the same for the same analysis. For example: analysis for kjeldahl nitrogen or available phosphorus in soil have to find the same result with the same sample whatever the lab where the analysis is done. That is the main challenge of an intercalibration. It is possible to do it by exchange of the soil internal references of each laboratory and also by analysing CRM (Certified Reference Material) provided by international organisms or governmental agencies. The interest of an internal reference is to get a no costly sample which can be analysed like a Quality Control in every serie of analysis. The interest of a CRM is to calibrate a protocol to get a result nearby the certified value and within the certified range for every routine analysis.

The first step of our proposal is to have a better knowledge of each laboratory by the way of a form we will send to the lab managers and which will summarise the main features of each lab.

The second step for the soil analytical laboratories is to exchange the internal reference of each lab with the others and analyse the routine analysis (LDD and DALAM already have started that).

The third step is to buy CRM for soil, plant and water analysis. This CRM can be used to calibrate a protocol and also, for water analysis, to follow all the series of analysis as a Quality Control.

According to the budget, a fourth step could be to organize trainings for laboratory managers on one hand and for technicians on the other hand. A final step could be to organize a workshop gathering the lab managers in order to share all the analytical results of intercalibrations, discuss how to optimize some protocols when there is a gap with the certified values and how to built and manage a Quality system in each lab.

Written by:

Nopmanee Suvannang,
Coordinator of LMI LUSES

Jean-Louis Duprey
Team manager of MOANA, US IMAGO

Sent to:

- Tran Duc Toan, deputy director of Science and International Cooperation Management, SFRI
- Tran Minh Tien, Head Department of Soil Genesis and Classification, SFRI
- Do Duy Phai, head of Central Laboratory for Soils, Plants and Fertilizers, SFRI
- Vu Duc Loi, deputy director of Institute of Chemistry
- Luu Thi Nguyet Minh, researcher, Institute of Chemistry
- Duong Tuan Hung, researcher, Institute of Chemistry
- Xaysatith Souliyavongsa, head of the NAFRI lab
- Pheng Sengxua, director of ALUPC
- Oloth Sengtaheuanghoung, deputy director of ALUPC
- Nopmanee Suvannang, director of the Soils Analyisis Technical Service, LDD, coordinator of LMI LUSES
- Alain Brauman, IRD scientist, UMR ECO&SOLS, coordinator of LMI LUSES
- Didier Orange, IRD scientist, UMR242 iEES-Paris
- Christian Hartman, IRD Scientist, UMR242 iEES-Paris
- Jean-Louis Duprey, IRD engineer, US IMAGO

Copy to:

- Robert Arfi , IRD Scientist, director of DER
- Yves Gouriou, IRD scientist, director of US 191 IMAGO
- Jean-Luc Chotte, IRD Scientist, director of UMR ECO&SOLS
- Christian Valentin, IRD Scientist, deputy director of UMR242 iEES-Paris
- Michel Grimaldi, IRD Scientist, team manager of « Fonctionnement Biophysique du sol », UMR242 iEES-Paris
- Jean Riotte, IRD scientist, coordinator of LMI CEFIRSE