SCOPING STUDY #1:
TERRESTRIAL CARBON ACCOUNTING:
ACADEMIC BASELINES

Centre for Climate Risk & Opportunity Management
in Southeast Asia Pacific (CCROM - SEAP)
Bogor Agricultural University

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CHAPTER 1 : INTRODUCTION

Many REDD+ implementing countries begin with capacity building programs focused on forest carbon monitoring and accounting. Despite these countries lack a sufficient group of domestically-trained terrestrial carbon accounting (TCA) professionals. At present, there are many TCA related programs or trainings in Indonesia, but none provide a comprehensive academic curriculum for developing TCA professionals. Many workshops and training programs have been held to build capacity for TCA throughout Indonesia, most of which are only a few days in length and do not cover enough depth to develop skilled TCA professionals.

The newly merged Indonesian Ministry of Environment and Forestry (MOEF) is also considering developing two to three-day certificate programs in carbon measurements for all major sectors. The short-term courses while provide basic skills on field measurements will not likely be able to provide an in-depth knowledge necessary to account for natural variations in forest carbon distribution, nor rigorous statistical procedures for accounting uncertainly of measurements, required by funding agencies such as World Bank's FCP program for performance based payments. Indonesian academics have just begun organizing an Indonesian Expert Association of Climate Change and Forestry in recognition of unmet needs to train Indonesians in REDD+ and TCA topics. CCROM will seek their inputs and work together to achieve common goal of developing skilled TCA professionals. However, significant gaps remain and efforts to consolidate these programs to make TCA educational opportunities coherent and sustainable have been hindered by lack of resources and the focus on appropriate academic engagement.

The Greenhouse Gas Management Institute (GHGMI), Indonesia and China jointly received a grant from Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety of the Federal Republic of Germany, to develop country specific internationally recognized comprehensive TCA programs in Indonesia and China. Each country will develop their TCA program based on successful comprehensive TCA Certificate program run by the University of California-San Diego. In order to gather existing academic baseline in Indonesia, Center for Climate Risk and Opportunity Management on Southeast Asia and Pacific (CCROM SEAP) undertook the first scoping study, with a goal of documenting existing in-country offering of academic curriculum relevant to TCA. The study was supported by GHGMI.

The study focused on following:

a. TCA related courses that already being offered *within* Bogor Agricultural University.
b. TCA related courses that already being offered at *other* universities in Indonesia.
c. TCA capacity building initiatives have been done, or are on-going, *outside* of IPB and other universities.

CHAPTER 2 : EXISTING IN-COUNTRY ACADEMIC TCA INSTRUCTION

There are many TCA related instructions offered at a wide range of colleges, universities, and research agencies. We summarized TCA related instructions from a number of universities/institutions related to the six topics of the TCA Instruction (Table 2.1).

TABLE 2.1. TOPICS OF THE TCA INSTRUCTION

No	Topics	Sub-Topics
1	Policy Context	1. UNFCCC (INDCs and NDF, national GHG inventories, REDD+ reference levels, MRV under the Paris Agreement) 2. Other guidance (World Bank, voluntary markets, sub-regional markets, relevant standards, including for verifiers) 3. National and provincial forest policies and national GHG policies and reporting 4. Social landscape and safeguards (land ownership, indigenous people
2	GIS/ remote sensing	1. GIS Software (ArcGIS, QGIS, GRASS, IDRISI) including GPS Use 2. Remote sensing and generating activity data including supervised and unsupervised classifications 3. Software tools (e.g., ERDAS Imagine, ENVI, Google Earth Engine, CLASLite, IMGTools)
3	Land classifications and IPCC Guidance and Guidelines	1. Applying the 2006 IPCC Guidelines 2. National forest classification maps, forest types and classes 3. National forest inventories 4. Time series maps with land classifications 5. Data quality and control, archiving of data
4	Data collection, field methods, and evaluation, generation of emissions factors	1. Forest measurements 2. Allometric equations. 3. Forest carbon inventories 4. Generating emission factors 5. Evaluating data quality and methodological appropriateness.
5	TCA Statistics	1. Error propagation including overview of general statistics 2. Uncertainty analysis (bootstrap, Monte Carlo methods), 3. Regression 4. Use of software (including R code package) 5. Statistics applied to forests/forest carbon
6	Nationally-appropriate communication of TCA results	1. UNFCCC reporting (e.g., national communications, NDC) 2. Reporting requirements to government entities within Indonesia and China (e.g., PEP reporting) 3. REDD+ reporting (e.g., FCPF, FIP, bilateral) 4. Formatting analysis of results for reporting requirements 5. Good communication (presentation and writing) generally

2.1. BOGOR AGRICULTURAL UNIVERSITY

Bogor Agricultural University (IPB) has undergraduate and graduate programs. Undergraduate program at IPB is a 4-year program and consist of 37 different departments. Since 2005, IPB has offered major-minor curriculum consisting of more than 500 combinations of competencies. While the School of Graduate Studies of IPB offers 65 Major courses for Master Degree Program and 43 Major Courses for Doctoral Degree Program. In line with the six issues of the TCA Instruction, several courses at IPB also deliver subjects related to the topics and sub-topics of the TCA (see Table 2.1).

Results of the assessment of undergraduate and graduate curricula and the accompanying discussion are described in the following sections.

2.1.1 Number of the Study Program under Undergraduate and Graduate Programs Offering Courses Related to the TCA Instruction.

For the undergraduate programs, there are 11 of 37 study programs offering courses related to the TCA Instruction. For graduate programs, there are 23 of 65 master degree programs and 11 of 43 doctoral degree programs offering courses related to the TCA Instruction. The names of the study programs are summarized in Table 2.2. Most of the study programs are mainly from Faculty of Mathematic and Natural sciences, Faculty of Forestry, and Faculty of Agriculture (Figure 2.1). Graduates of undergraduate and graduate programs have distinguished fundamental competency in the area described by learning outcomes. However, the TCA competencies are not explicitly described in the learning outcomes.

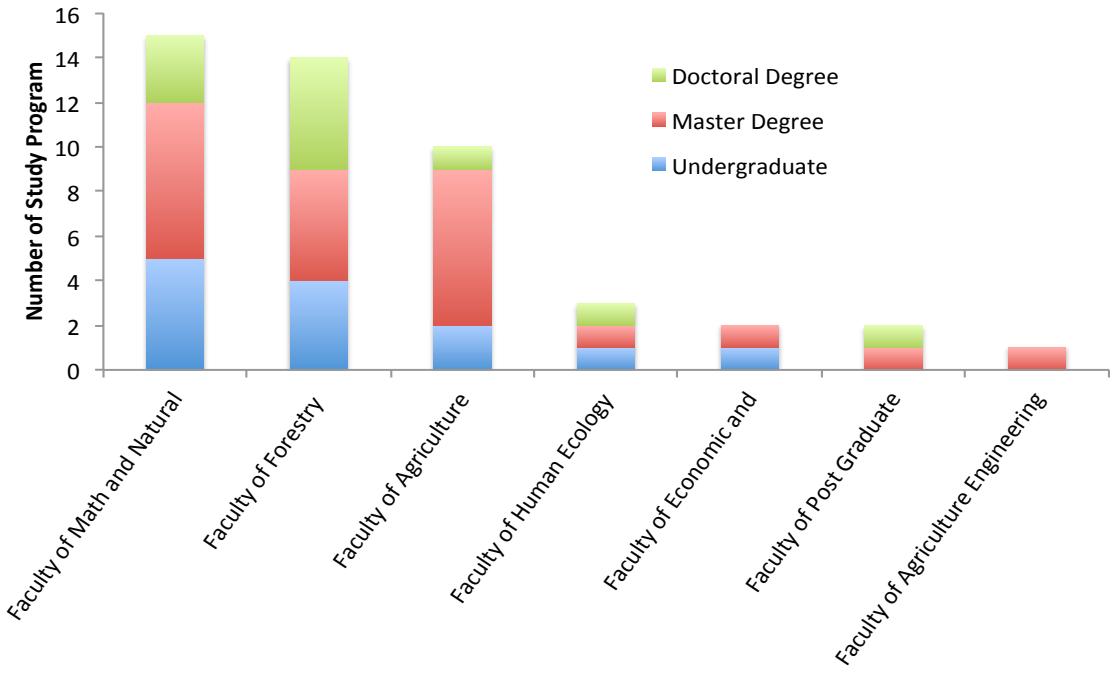

Figure 2.1. Number of Study Programs Offering Courses Related to the TCA Instruction at IPB

Table 2.2. Study programs under undergraduate and graduate level offering TCA related courses

No	Under Graduate (S1)	Master Program (S2)	Doctoral (S3)
1	Soil Science and Land Resources	Forest Product Technology and Science	Forest Product Technology and Science
2	Landscape Architecture	Forest Management Science	Forest Management Science
3	Forest Management	Tropical Silviculture	Tropical Silviculture
4	Forest Products	Tropical Biodiversity Conservation	Tropical Biodiversity Conservation
5	Natural and Forest Resource Conservation	Management of Ecotourism and Environmental Services	Management of Ecotourism and Environmental Services
6	Silviculture	Landscape Architecture	Watershed Management
7	Forest Conservation and Ecotourism	Soil Agrotechnology	Rural and Regional Development Planning Science
8	Statistics	Soil & Environment Biotechnology	Applied Climatology
9	Applied Meteorology	Soil Science	Crop Biology
10	Mathematics	Mitigation of Land Damage Disaster	Statistics
11	Computer Science	Regional Planning Science	Natural Resource Management & Environment
12	Resource Economic and Environment	Watershed Management	
13	Communication Science and Community Development	Civil Engineering and Environment	
14		Resource Economic and Environment	
15		Rural and Regional Development Planning Science	
16		Applied Climatology	
17		Applied Mathematics	
18		Statistics	
19		Crop Biology	
20		Applied Statistics	
21		Computer Science	
22		Information Technology Management	
23		Environmental & Natural Resource Management	
Total	13	23	11

2.1.2 COURSES OFFERED BY THE STUDY PROGRAMS AT IPB RELATED TO TCA INSTRUCTION

In undergraduate programs, most of the courses offered in each study program may include one or more of following TCA Instructions: TCA statistics, field method, GIS/RS, policy context, and IPCC guideline. None is related to communication of results, except course related to method and technique of communication, which is not really connected with the communication results of climate mitigation actions. In overall, the TCA instructions are more related to TCA statistics, followed by filed methods, policy and GIS/RS (Figure 2.2.). The number of course related to TCA statistics and field method is higher than other because statistic curriculum exists in all study programs at IPB with a many variety of courses. In addition, course on field method is also found in many study programs at faculty of forestry, faculty of mathematic and natural science, and faculty of agriculture at IPB.

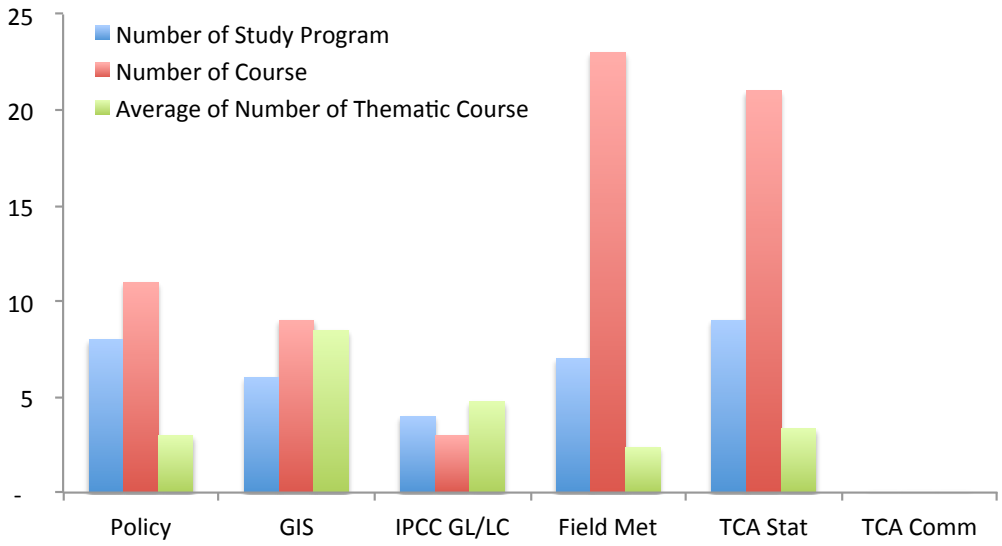

Figure 2.2. Number of course related to TCA Instruction in undergraduate program

Similar characteristics on TCA instructions are also found in the graduate program. The courses offered in each study program may include only one to five TCA Instructions particularly TCA statistics, field method, GIS/RS and policy context. None is related to the results communication of climate mitigation actions in master program (Fig 2.3), while in doctor program there is no course related to the communication of results and policy (Fig 2.4).

Comparing the content of course related to TCA with TCA instruction, most of the courses offered in each study program may contain between 9% and 61% of the TCA instructions in undergraduate program, between 27% and 64% in master program, and between 38% and 64% in doctor program. Overall, around 60% of the contents of GIS/RS match with the TCA instruction of GIS/RS, while there is no instruction on communication of climate mitigation actions (Fig 2.5). This data demonstrated that the graduations from the study programs housing courses related to the TCA instruction do not yet meet the competency/contents of professional TCA programs, because by the end of semester/study the graduates only achieve a limited TCA instructions, particularly in communication, policy and IPCC guideline.

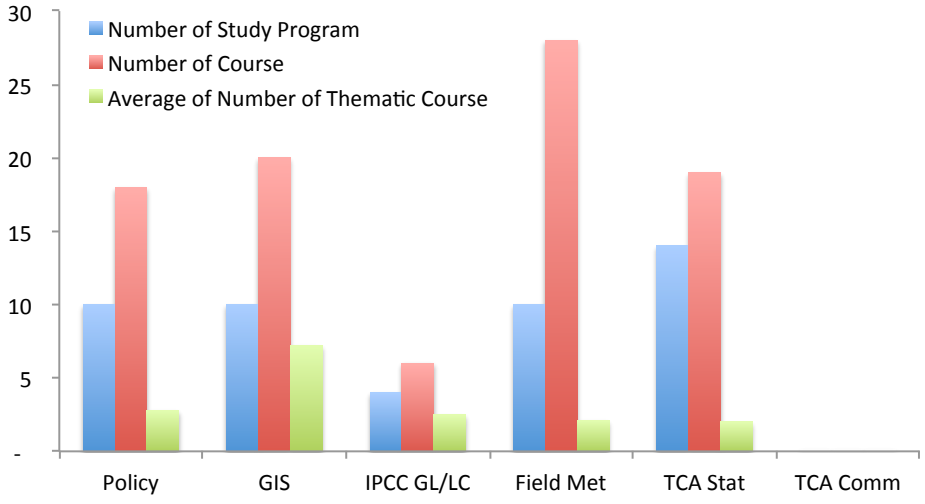

Figure 2.3. Number of course related to TCA Instruction in master program

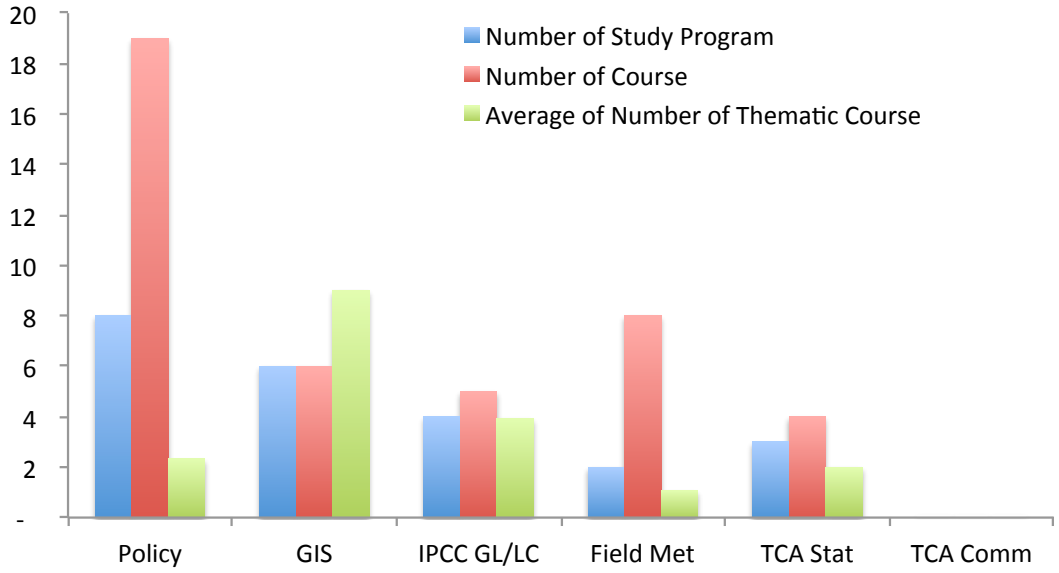

Figure 2.4. Number of course related to TCA Instruction in doctor program

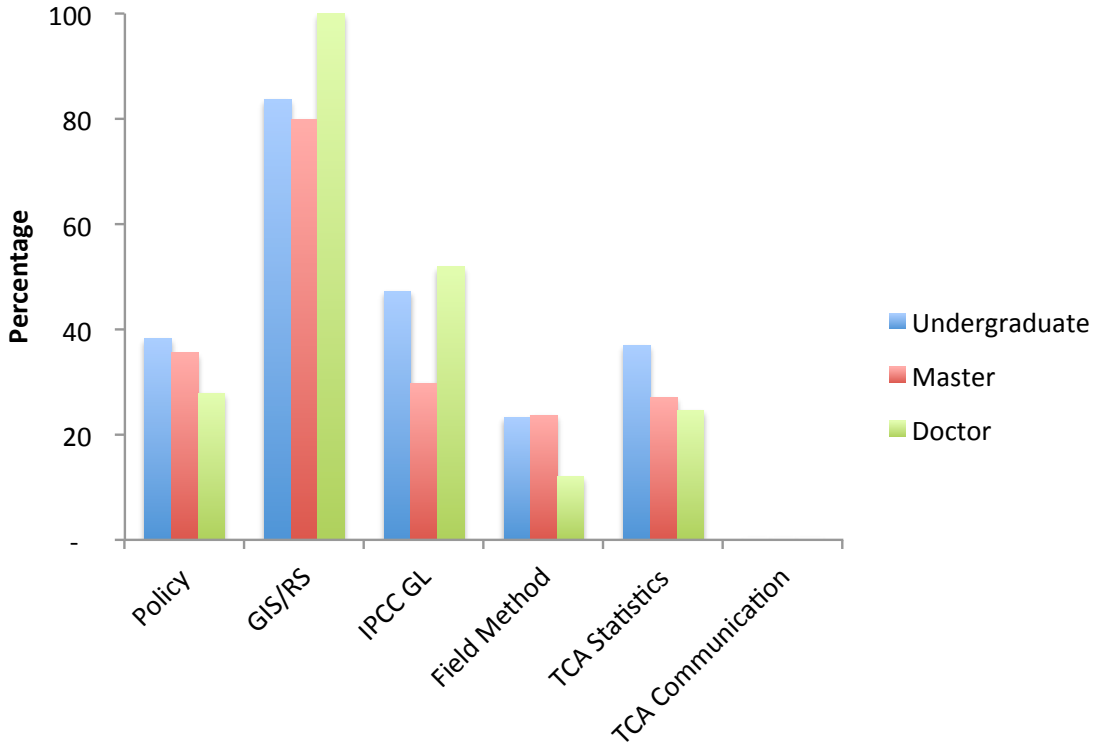

Figure 2.5. The content of course related TCA

2.2. OTHER STATE UNIVERSITIES

The scoping study related to TCA outside IPB was carried out at state universities, i.e. University Mulawarman (UNMUL, East Kalimantan Province), University of Sumatra Utara (USU, North Sumatra Province), University of Tanjungpura (UNTAN, West Kalimantan), University of Gajah Mada Gajah (UGM, Yogyakarta Province), and University of Hasanuddin (UNHAS, South Sulawesi Province). We focused on the faculty or study

program that is most related to the TCA, namely faculty of forestry particularly for undergraduate program.

Similar to IPB, the undergraduate program from the above universities is 4-year program. The duration of undergraduate program ranges between 8 semesters and maximum of 14 semesters (7 years). Students graduate with approximately 145 course credits. The courses relevant to TCA instruction are listed in Table 2.3.

Table 2.3. Courses related to the TCA offered by undergraduate programs based on 6 TCA instructions at universities outside IPB

No	Thematic Areas	Required by the program?	Courses	UN-MUL	USU	UN-TAN	UN-HAS	UGM
1	Policy Context	No	Introduction to Forestry Science and Environmental Ethics (PIKEL)		X	X	X	
		No	Forestry Policy and Regulation	X		X	X	X
		No	Sustainable forest management				X	X
2	GIS	Yes	Geodetic and Cartography	X		X		
			Remote Sensing for Forest Application	X		X	X	X
			Data Base System	X				
			GIS on Forest Application	X	X	X	X	X
			Survey and Forest Mapping				X	
			Information System for forest Management				X	X
			Forest Geomatics				X	
3	IPCC Guidelines/ Land Classification	Yes	Forest Ecology	X	X	X	X	X
			Tree Measurement	X				
			Biology		X			
			Management of Environmental Services		X	X	X	
			Dendrology	X		X		
			Spatial Land Management	X				
			Agroforestry and Social Forestry	X	X			
			Bioenergy and biomass conversion	X				
4	Field Methods	Yes	Forest resource Inventory	X	X	X	X	
			Forest harvesting	X			X	X
			Forest Carbon Inventory			X		
			General Forestry Practical work		X		X	X
			Sustainable forest management practical work				X	X
			Forest Use practical work				X	X
			Field Work	X	X	X		
5	TCA Statistics	Yes	Mathematics	X	X		X	
			Statistics Non Parametric	X				
			Statistic	X	X		X	
			Carbon accounting				X	X
			Regression Analysis for Forestry					X
			Forest Biometric	X	X		X	X
6	TCA Communi-cation	No	None					

In general, the courses offered in each study program may include one to five TCA instructions, TCA statistics, field method, GIS/RS, IPCC guideline and policy context. There is no course related to the result communication of mitigation actions offered by any of the study programs. This issue was also found at IPB, where courses really connected to communication are none. Study program of forest management of University Mulawarman seems offer many courses related to 4 TCA Instructions.

2.3. Government and Non-Government Institutions

As mentioned previously, there are so many training program taught by government or non-government institutions in Indonesia that deal with some TCA instruction, particularly the ones related to REDD+. The training programs are basically designed based on target participants and implemented through a combination of lectures, practical and field work. For local government, training is provided through learning by doing process.

The training related to the TCA is usually 1 day, but could be as long as 1 week. Technical support during and after the training depends on target participants. Below, we describe the training program conducted by the Government and Non-Government Institutions for different target participants.

2.3.1 Pusat Pendidikan dan Pelatihan Kehutanan (Center for Forest Education and Training, MOEFI)

The Center for Forest Education and Training, supported by lecturers (widyaiswara) from MOEFI and partners, has conducted trainings and is setting up regular training programs related to climate change and REDD +.

The trainings are basically intended to increase the capacity of either government officers or non-government officers such as policy makers, academic, NGOs, private, and communities in addressing the issue of climate change and REDD+. The type of training programs are grouped into general training, technical training, carbon accounting, MRV and REL, and safeguard, with duration of training program ranging from 1 to 8 days. Each type of training program is divided into 6 different training topics depending on target participants. The main materials for all 6 training type of general training are listed in Table 2.4.

Table 2.4. Main Material of General Training Program and its connection with TCA Topics

No	Main material of General Training	TCA Topic
1	Facilitation technique	Field Measurement
2	Land cover change measurement	Field Measurement
3	Participatory Method	Field Measurement
4	Adult learning	Other
5	Action Plan	Policy
6	Additionality, Leakage and Permanence	Policy
7	Climate change	Policy
8	Climate change and REDD	Policy
9	Co-benefit REDD+ in conservation area	Policy
10	Community based-climate change mitigation activities	Policy
11	Community role in addressing climate change	Policy
12	Deforestation & Degradation	Policy
13	Forest and Function	Policy
14	Forest carbon program and REDD in their region	Policy
15	FPIC	Policy
16	Integration of REDD+ into local policy	Policy
17	Introduction to Climate Change	Policy
18	Introduction to REDD	Policy
19	MRV	Policy
20	Planning climate change adaptation and mitigation	Policy
21	Policy of MoEF in Climate Change	Policy
22	Proposal preparation related REDD+ program	Policy
23	REDD Action Plans	Policy
24	REDD Framework	Policy
25	REDD+ Concept	Policy
26	REDD+ development	Policy
27	Role and function of conservation area as carbon sequestration	Policy
28	Strategy for awareness rising	Policy
29	Development of facilitation materials/media	Result Communication
30	Effective communication	Result Communication
31	Reporting	Result Communication

In general, there are 31 main materials delivered at the 6 different types of training listed above. Most of them are related to the TCA policy (77%) followed by field measurement (10%), result communication (10%), and other (3%). None is connected to the IPCC guideline, GIS/RS, and TCA statistics. Curricula of general training and its relationship with TCA topic is presented in Table 2.5.

Table 2.5. Curricula of General Training Program and its connection with TCA Sub-Topics

TCA Topic	TCA sub-topic	Main material of general training	Duration
Policy context (80%)	UNFCCC (INDCs, national GHG inventories, REDD+, REDD+ reference levels)	Climate Change	3 hours
		Role of Forests in Climate Change	2 Hours
		Deforestation and Degradation Triggers	3 hours
		International and national schemes and strategies to implement REDD+	3 hours
		REDD+ in Concept: REDD + as a Form of Payment for Environmental Services	
		Key Concept of REDD+	2 Hours
		REDD+ Implementations	3 hours
	National and provincial forest policies	International and national schemes and strategies to implement REDD+	3 hours
	Social landscape and safeguards (land ownership, indigenous people rights, shifting cultivation)	Risk of REDD+ Development	2 Hours
		Social Safeguards in REDD+	
		Climate Change and REDD for Stakeholders in the Grassroots.	5 Hours
IPCC Guidelines/land classification (25%)	National forest classification maps	Practice for Preparation of Action Plan considering forest function	12 Hours
Field methods (40%)	Forest Measurement	Carbon Measurement, Baseline and MRV	2 Hours
	Allometric equations	Carbon Measurement, Baseline and MRV	2 Hours

Table 2.5 shows that TCA relevant sub-topic curricula cover 80% policy context, 40% field method, and 25% IPCC guideline/land classification, while GIS/RS and TCA statistics are not delivered in the program. This is because the main objective of this general training is awareness rising on issues of climate change and REDD+.

2.3.2 Locally Appropriate Mitigation Action in Indonesia (LAMA-I) implemented by ICRAF, CCROM-IPB and GIZ

Since 2013, LAMA-I project financed by DENIDA has been supporting local government in preparing low carbon development and mainstreaming it to the local development planning. Six districts of 2 province in Indonesia have been involved in this project, with 3 main activities, i) formulating policy, building REL, and preparing counter measures and MRV; ii) developing tool for spatial plan considering low emission, and iii) strengthening institutional arrangement and increasing local capacity.

One of activities for increasing local capacity is performed through training low carbon development using LUMENS (Land Use Planning for Multiple Environmental Services) software developed in the LAMA-I project. The target participants are members of working group for low carbon development at local governments along with some academic and NGOs. Learning method is class meeting and practical (48 hours) followed by technical backup for the working group, to develop local action plan for low carbon. Curricula of LUMENS training and its relationship with TCA topic is summarized in Table 2.6.

The curricula of LUMES training program contains between 10% and 75% TCA instructions, i.e. policy context 75%, IPCC guidelines/land classification 60% and GIS/RS (10%).

Table 2.6. Curricula of LUMENS Training on LED and its connection with TCA Sub-Topics

TCA Topic	TCA sub-topic	Main material of LAMA-I training	Duration
Policy context (75%)	UNFCCC (INDCs, national GHG inventories, REDD+, REDD+ reference levels)	Introduction of the Land Use Planning for Low Emission Development Strategy (LUWES).	15 minutes
		REL calculation is based on land use changes in the past	30 minutes
		Making baseline scenario using linear projection	3 hours
		Making baseline scenario is based on the development plan	1.5 hours
		Identification of potential activities for emission reduction	1.5 hours
		Identification of potential activities to reduce emissions into the probability matrix of land use changes.	2 hours
		Analysis and conclusions of each baseline scenario and emission reduction actions	2 hours
		Calculating the impact of emission reduction action plan	3.5 hours
		Extracting and presentation of data	4 hours
		Latest Developments in Climate Change Policy in Indonesia: BUR, INDC, FREE, RAD-GRK	1 hour
		Reference Emission Level: Historical and Forward Looking	2.5 hours
		Tagging Methods: identifying gaps and contribution of current development plan/program toward low carbon	1 hour
		Tagging process mitigation actions	6.5 hours
	National and provincial forest policies	Policy and plan for reducing emission (National and Province)	15 minutes
		Trade-off Analysis	1 hour
		Trade off Profitability Data Analysis Using Land Use	2.5 hours
	Social landscape and safeguards (land ownership, indigenous people rights, shifting cultivation)	Results of land use planning assessment ; Integration with the principles, criteria and indicators of social safeguards; Develop an implementation plan.	3 hours
GIS/RS (10%)	Remote sensing & generating AD	Preparation of land use change activity data	15 minutes
IPCC Guidelines/land classification (60%)	Forest types and classes	Building a planning unit	15 minutes
	National forest inventory	C-Stock and C-stock difference	15 minutes
	Time series maps with land classifications	Identification of local land use systems.	1 hour
		Inventory of land use change types and the history of land use changes.	2 hours
		Identification of the factors triggering changes in land use	2 hours
		Estimated land use for the future.	2 hours
		Formulation of Unit Planning and Analysis of Land Use Change.	1.5 hours
		Identify drivers of LUC and Relationship Between factors	3 hours

2.3.3 CER-INDONESIA

The Center for Environment Research (CER) Indonesia conducted training program on Climate Change and REDD+. This 4 days training was designed to build rigorous and improved skills of private sector for implementing REDD+. The cost for implementing 4 days training is 200 million IDR for 20 participants. The learning method consists of class meeting and practical meeting for 4 days (32 hour).

Related to the TCA topics, the courses delivered for the training contains field methods around 16 hours, policy context 10 hours, and IPCC Guideline 6 hours (Table 2.7). The facilitators were from Universities and Research Agencies in Indonesia including Bogor Agricultural University and Forest and Environmental Research and Development Agency (FORDA) of MOEFI.

Table 2.7. Curricula of REDD+ Training and its connection with TCA Sub-Topics

TCA Topic	TCA sub-topic	Main material of general training	Duration
Policy context (75%)	UNFCCC (INDCs, national GHG inventories, REDD+, REDD+ reference levels)	1. Greenhouse Gas Inventory in Forest Sector	2 hours
		2. Opportunities, Challenges and Implementation Phase A / R CDM and REDD in Indonesia	2 hours
		3. Project Design Document (PDD) Preparation	2 Hours
	Other guidance (World Bank, voluntary markets, sub-regional markets, relevant standards, including for verifiers)	Institutional A / R CDM and REDD: Challenges and Agenda	2 Hours
	National and provincial forest policies	Policy, Funding Opportunities and Indonesia Forest Carbon Markets	2 hours
IPCC Guidelines/land classification (60%)	Forest types and classes	Carbon Accounting and Forest Data	2 hours
	National forest inventory	Greenhouse Gas Inventory in Forest Sector	2 hours
	Time series maps with land classifications	Carbon Accounting and Forest Data	2 hours
Field methods (80%)	Forest measurements	Carbon Accounting and Forest Data	2 hours
	Allometric equations	Forest Biomass and Carbon calculations and Field Work	10 hours
	Forest carbon inventories	Measurement of Carbon Stock in Peatlands Area	2 hours
	Generating emission factors	Greenhouse Gas Inventory in Forest Sector	2 hours

2.3.4 REDD ACADEMY: COLLABORATION BP REDD AND UNEP

The REDD$^+$ Academy began on October 2014, initiated by the UN-REDD Programme and the UNEP Environmental Education and Training Unit. This initiative is part of capacity development to deliver REDD+ on the ground. The main objective of the REDD+ Academy is to build the knowledge base for REDD+ readiness and implementation, in particular for REDD+ decision-makers from sectors outside of forestry/environment. Similar to other trainings, most of the topics are related to Policy Context (75%), while other topics are quite limited. Topics on the TCA Statistics and TCA communication are lacking. Methods of training are mostly classroom instructions and sharing lesson learnt among participants.

Table 2.8. Curricula of REDD+ Academy and its connection with TCA Sub-Topics

TCA Topic	TCA sub-topic	Main material of general training
Policy context	UNFCCC (INDCs, national GHG inventories, REDD+, REDD+ reference levels)	Forests, Carbon Sequestration & Climate Change
		Introduction to REDD+ and the UNFCCC
		Drivers of Deforestation and Forest Degradation
		Economics and Finance of REDD+
		Approaches for Allocation of Incentives
	National and provincial forest policies	REDD+ National Strategies and Action Plans (NS/AP)
		Policies and Measures for REDD+ Implementation
	Social landscape and safeguards (land ownership, indigenous people rights, shifting cultivation)	Country approaches to REDD+ Safeguards
		Public awareness and stakeholder engagement
IPCC Guidelines/land classification	National forest inventory	National Forest Monitoring Systems
Field methods	Evaluating data quality and methodological appropriateness	Forest Reference (Emission) Levels (FREL/FRLs)

2.3.5 RCCC-UNIVERSITY OF INDONESIA

Research Centre for Climate Change (RCCC) at the University of Indonesia also offers training program related to the TCA. The training is targeted for professionals. Methods of teaching are mostly classroom instructions with a few hours of practical training. The duration of the training is 4 days (32 hours). Topics of the training are dominated by policy aspect (50%). About 25% of the time is focused for GIS and another 25% of the time is for IPCC Guideline.

There are 8 modules in the training of which 5 modules related to the policy aspect of the TCA, 2 related to GIS and 1 related to IPCC Guideline. The module related to Policy context include i) Introduction to climate change, ii) Environmental economic and natural resources, iii) Socio-economic aspect of management of conservation forest, iv) Legal aspect on Management of conservation forest and v) Business on Forest Conservation Management (Ecotourism). Modules on GIS include i) Remote sensing for forest and estimation of carbon stock, and ii) GIS and module related to IPCC Guideline only covers Monitoring biodiversity and forest.

Different from other trainings, the training offered by the RCCC requires fee. Cost of each module is 5 million IDR per participant. If all modules are taken by participant, the cost for the training will be about 40 million IDR (3.5 k USD) per participant.

CHAPTER 3 : GAPS OF THE IPB COURSES ON THE TCA

As described above, most the courses and trainings conducted by universities do not fully meet the TCA curriculum standards. The following sections described briefly the gaps of the existing curriculum at IPB with the TCA instructions.

3.1. POLICY CONTEXT

Courses in the study programs at IPB offering instruction related to TCA policy under undergraduate (S1), master (S2) and doctoral degree (S3) are 30, 42, 40 courses respectively (Table 3.1). However thematic courses (subjects) in each course only cover less than 50% of the TCA Policy topics. This indicates that there is no single course that fully covers the policy aspect on the TCA (Figure 3.1). The sub-topic of the TCA Policy receiving minimum attention in the course is the one related to carbon market and standard.

Table 3.1. Number of Courses in each Study Program and Faculty at IPB related to TCA Policy

	Faculty	Study Program	P1	P2	P3	P4	Total
S1	Faculty of Agriculture	Landscape Architecture			1		1
	Faculty of Economic and Management	Resource Economic and Environment			2		2
	Faculty of Forestry	Forest Management	3		4	4	11
		Forest Product	2		2		4
		Forest Resource Conservation and Ecotourism	2		2		4
		Silviculture	2		2	1	5
	Faculty of Human Ecology	Communication Science and Community Development			1		1
	Faculty of Math and Natural Sciences	Applied Meteorology	1		1		2
Total_S1			10		15	5	30
S2	Faculty of Agriculture	Mitigation of Land Damage Disaster	1		1		2
		Regional Planning Science			2	2	4
		Soil Biotechnology and Environment	1		1	1	3
	Faculty of Economic and Management	Resource Economic and Environment	1		1	1	3
	Faculty of Forestry	Ecotourism Management and Environmental Services	1	1	1		3
		Forest Management Science	3		3	2	8
		Tropical Biodiversity Conservation			1		1
	Faculty of Human Ecology	Rural and Regional Planning Development Science			1		1
	Faculty of Math and Natural Sciences	Applied Climatology	3	1	3	3	10
	Faculty of Post Graduate	Natural Resource Management and Environment	2		4	1	7
Total_S2			12	2	18	10	42
S3	Faculty of Agriculture	Watershed Management			1		1
	Faculty of Forestry	Ecotourism Management and Environmental Services			1		1
		Forest Management Science	5		6	6	17

	Faculty	Study Program	P1	P2	P3	P4	Total
		Science and Technology of Forest Product			1		1
		Tropical Biodiversity Conservation			2		2
	Faculty of Human Ecology	Rural and Regional Planning Development Science				1	1
	Faculty of Math and Natural Sciences	Applied Climatology	3		3	3	9
	Faculty of Post Graduate	Natural Resource Management and Environment	2		5	1	8
Total_S3			10		19	11	40

Note: P1, …, P4 refer to number 1, 2, .., 4 of sub-topic of the TCA Policy in Table 2.1

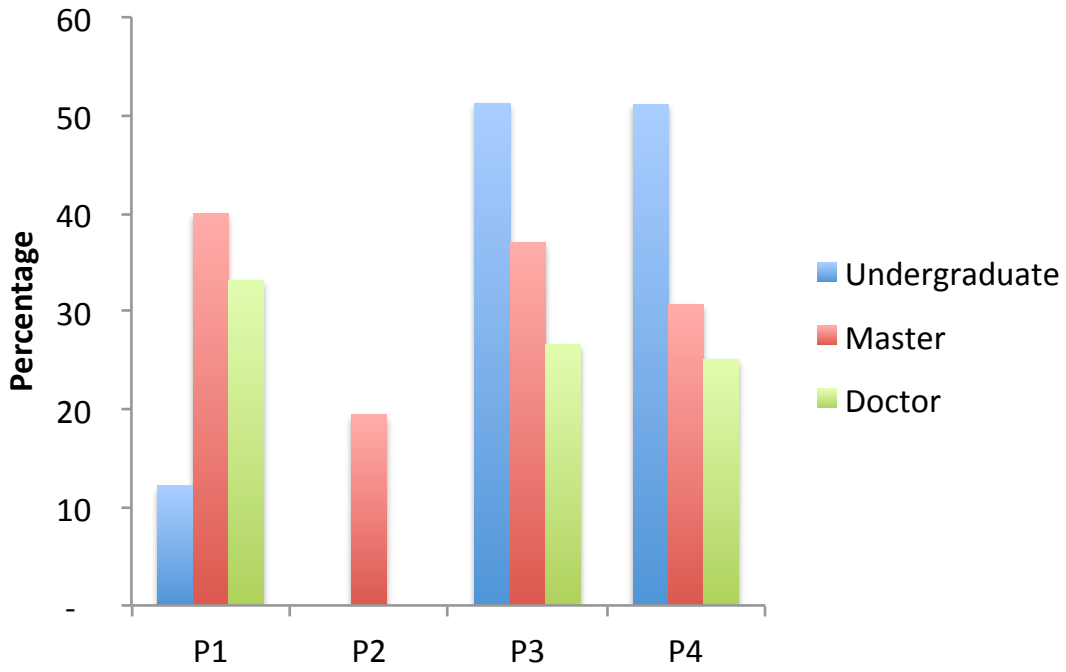

Figure 3.1. Percentage of subject content in each course related to Policy Aspect of the TCA

3.2. GIS AND REMOTE SENSING

In the case of GIS/RS course, the subject content of the GIS/RS course fits well with the GIS/RS sub topic of the TCA instructions. The study programs offering the GIS/RS course fit well with the TCA are 6 study program under graduate and 7 study program under master degree and 6 study program under doctoral degree (Table 3.2 and Figure 3.2).

Table 3.2. Number of Courses in each Study Program and Faculty at IPB related to GIS/RS of the TCA

Stratum	Faculty	Study Program	G1	G2	G3	Total
S1	Faculty of Agriculture	Soil Science and Land Resources	3	2	3	8
	Faculty of Forestry	Forest Management	2	2	2	6
		Forest Resource Conservation and Ecotourism	2	2	2	6
		Silviculture	1	1	1	3
	Faculty of Math and Natural Sciences	Applied Meteorology	1	1	1	3
		Computer Science	2	2	2	6
S1_Total			**11**	**10**	**11**	**32**
S2	Faculty of Agriculture	Landscape Architecture	1	1	1	3
		Mitigation of Land Damage Disaster	5	5	5	15
		Regional Planning Science	6	6	6	18
		Watershed Management	4	4	4	12
	Faculty of Agriculture Engineering	Civil Engineering and Environment	2	2	2	6
	Faculty of Forestry	Forest Management Science	1	1	1	3
		Tropical Biodiversity Conservation	1	1	1	3
	Faculty of Human Ecology	Rural and Regional Planning Development Science	1	1	1	3
	Faculty of Math and Natural Sciences	Information Technology Management	6	6	6	18
	Faculty of Post Graduate	Natural Resource Management and Environment	3	3	3	9
S2 Total			**30**	**30**	**30**	**90**
S3	Faculty of Agriculture	Watershed Management	1	1	1	3
	Faculty of Forestry	Forest Management Science	1	1	1	3
		Tropical Biodiversity Conservation	1	1	1	3
	Faculty of Human Ecology	Rural and Regional Planning Development Science	2	2	2	6
	Faculty of Math and Natural Sciences	Applied Climatology	1	1	1	3
	Faculty of Post Graduate	Natural Resource Management and Environment	1	1	1	3
S3 Total			**7**	**7**	**7**	**21**

Note: G1, …, G3 refer to number 1, 2, .., 3 of sub-topic of the GIS/RS in Table 2.1

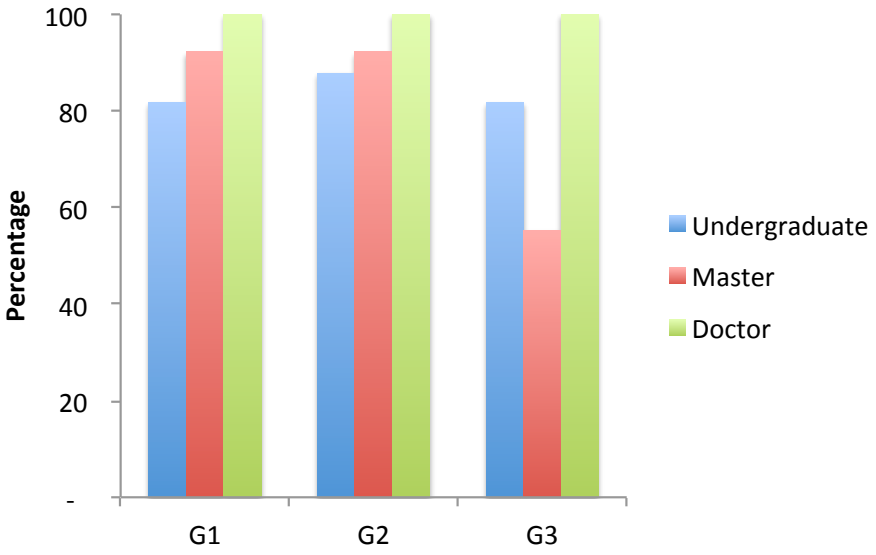

Figure 3.2. Percentage of subject content related to GIS/RS of the TCA.

3.3. LAND CLASSIFICATIONS AND IPCC GUIDANCE AND GUIDELINES

There are 12 study programs at IPB offering course that containing subject related to land classifications and IPCC Guidance. The study program covering most of the TCA sub-topics is Applied Climatology (Table 3.3). The TCA sub-topic that is less covered by the subject is the ones related to data quality control and data archiving system (Figure 3.3, c.f. Table 2.1).

Table 3.3. Number of Courses in each Study Program and Faculty at IPB related to IPCC Guideline

	Faculty	Study Program	IP1	IP2	IP3	IP4	IP5	Total
S1	Faculty of Forestry	Forest Management		1	2	1		4
		Forest Product			1			1
		Forest Resource Conservation and Ecotourism			1			1
		Silviculture			2			2
S1 Total				**1**	**6**	**1**		**8**
S2	Faculty of Forestry	Forest Management Science		1	1		1	3
		Tropical Silviculture			1			1
	Faculty of Math and Natural Sciences	Applied Climatology	3	2	2	2	2	11
	Faculty of Post Graduate	Natural Resource Management and Environment			1			1
S2 Total			**3**	**3**	**5**	**2**	**3**	**16**
S3	Faculty of Forestry	Forest Management Science		1	1			2
		Tropical Silviculture			1			1
	Faculty of Human Ecology	Rural and Regional Planning Development Science			1			1
	Faculty of Math and Natural Sciences	Applied Climatology	2	2	2	2	2	10
S3 Total			**2**	**3**	**5**	**2**	**2**	**14**

Note IP1, …, IP5 refer to number 1, 2, .., 5 of sub-topics of the IPCC Guideline in Table 2.1

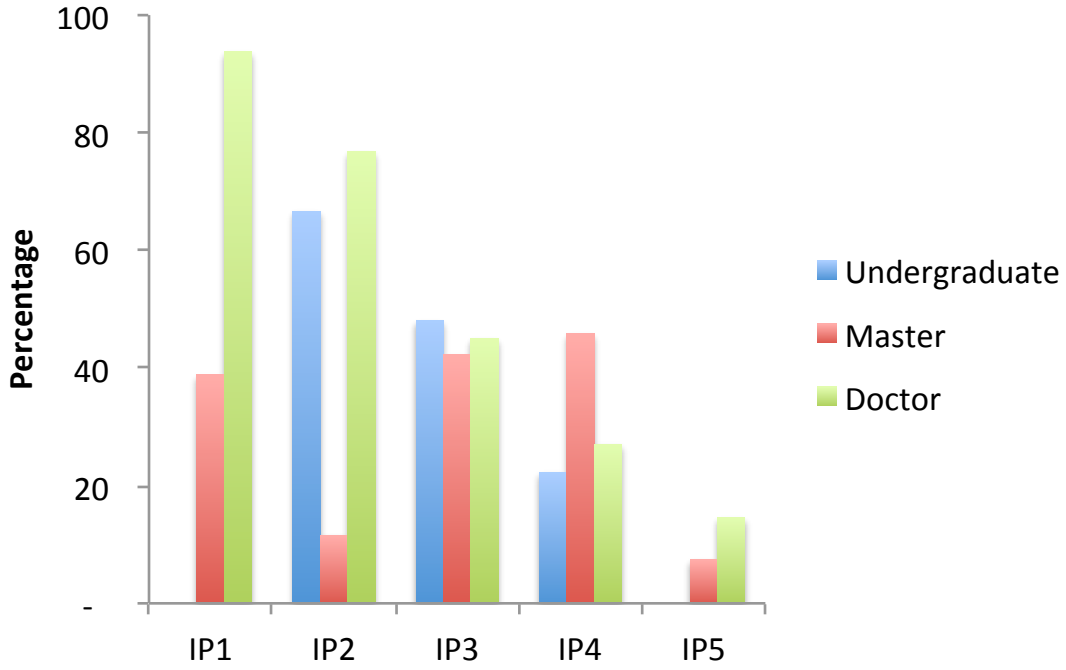

Figure 3.3. Percentage of subject content related to IPCC Guideline

3.4. DATA COLLECTION, FIELD METHODS, AND EVALUATION, GENERATION OF ACTIVITY DATA

Many courses offered by undergraduate and post graduate programs at IPB contains TCA topic on field method including evaluation and generation of activity data, i.e. 99 courses at Undergraduate, 63 courses at Master program and 12 courses at Doctoral Program (Table 3.4). However, percentage of subjects in each course covering the TCA topic is mostly less than 30% (Figure 3.4).

Table 3.4. Number of Courses in each Study Program and Faculty at IPB related to the Field Methods of the TCA

	Faculty	Study Program	FM 1	FM 2	FM 3	FM 4	FM 5	Total
S1	Faculty of Agriculture	Soil Science and Land Resources	9	2	3	2		16
	Faculty of Forestry	Forest Management	5	4	5	3	3	20
		Forest Product	4	3	4	3	3	17
		Forest Resource Conservation and Ecotourism	3	2	3	2	2	12
		Silviculture	9	5	7	4	3	28
	Faculty of Math and Natural Sciences	Biology	2		1			3
		Statistics	1		1		1	3
S1 Total			**33**	**16**	**24**	**14**	**12**	**99**
S2	Faculty of Agriculture	Soil Agro-technology	3	1	3	1	1	9
		Soil Biotechnology and Environment	2		1			3
		Soil Science	5		4			9
	Faculty of Forestry	Science and Technology of Forest Product			1			1
		Tropical Biodiversity Conservation	1					1
		Tropical Silviculture	4	2	3	2	2	13
	Faculty of Math and Natural Sciences	Information Technology Management	1		1			2
		Plant Biology	5	1	7		1	14
		Statistics	1		1		1	3
	Faculty of Post Graduate	Natural Resource Management and Environment	2	2	2		2	8
S2 Total			**24**	**6**	**23**	**3**	**7**	**63**
S3	Faculty of Forestry	Tropical Silviculture	1	1	1	1	1	5
	Faculty of Math and Natural Sciences	Applied Climatology	1					1
		Plant Biology			6			6
S3 Total			**2**	**1**	**7**	**1**	**1**	**12**

Note: FM1, …, FM5 refer to number 1, 2, .., 5 of sub-topics of the Field Method in Table 2.1

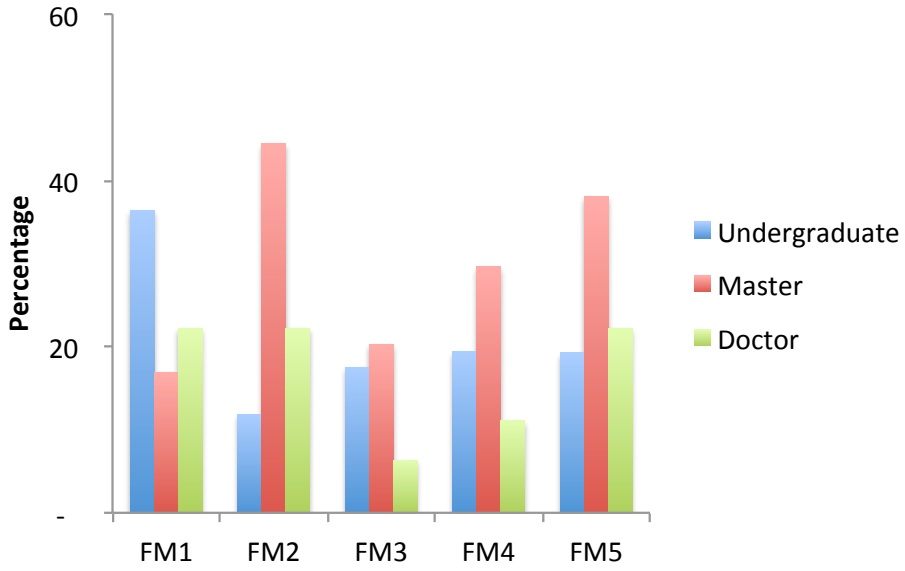

Figure 3.4. Percentage of subject content of the course related to the TCA Field Method

3.5. TCA STATISTICS

Like field method, many courses related to TCA statistics offered by the study programs at IPB. At least there are 107 courses at IPB offered instructions related to TCA statistics (Table 3.5). However, most of the subjects in each course contains limited TCA sub-topics (Figure 3.5). Subject contents in the related courses cover about 20% of the TCA Statistics.

Table 3.5. Number of Courses in each Study Program and Faculty at IPB related to TCA Statistics

	Faculty	Study Program	TCA 1	TCA 2	TCA 3	TCA 4	TCA 5	Total
S1	Faculty of Agriculture	Soil Science and Land Resources					1	1
	Faculty of Forestry	Forest Management		1	2		2	5
		Forest Product			1		1	2
		Forest Resource Conservation & Ecotourism			1		1	2
		Silviculture			1		2	3
	Faculty of Math and Natural Sciences	Applied Meteorology			1		1	2
		Computer Science	1	3	1	2	2	9
		Mathematics	1		3		2	6
		Statistics	1		7	2	7	17

	Faculty	Study Program	TCA 1	TCA 2	TCA 3	TCA 4	TCA 5	Total
S1 Total			**3**	**4**	**17**	**4**	**19**	**47**
S2	Faculty of Agriculture	Soil Agro-technology			1		1	2
		Soil Biotechnology and Environment			1		1	2
	Faculty of Forestry	Ecotourism Management and Environmental Services			1		1	2
		Forest Management Science		1	2		2	5
		Science and Technology of Forest Product			1		1	2
		Tropical Biodiversity Conservation			1		1	2
		Tropical Silviculture			1		1	2
	Faculty of Math and Natural Sciences	Applied Climatology			1		1	2
		Applied Mathematics	2				3	5
		Applied Statistics			5	1		6
		Computer Science		2				2
		Plant Biology			1		1	2
		Statistics			4	1	12	17
	Faculty of Post Graduate	Natural Resource Management & Environment					1	1
S2 Total			**2**	**3**	**19**	**2**	**26**	**52**
S3	Faculty of Forestry	Forest Management Science		1	1		1	3
	Faculty of Math & Natural Sciences	Statistics		1	1		2	4
	Faculty of Post Graduate	Natural Resource Management & Environment					1	1
S3 Total				**2**	**2**		**4**	**8**

Note TCA1, …, TCA5 refer to number 1, 2, .., 5 of sub-topics of the TCA Statistics in Table 2.1

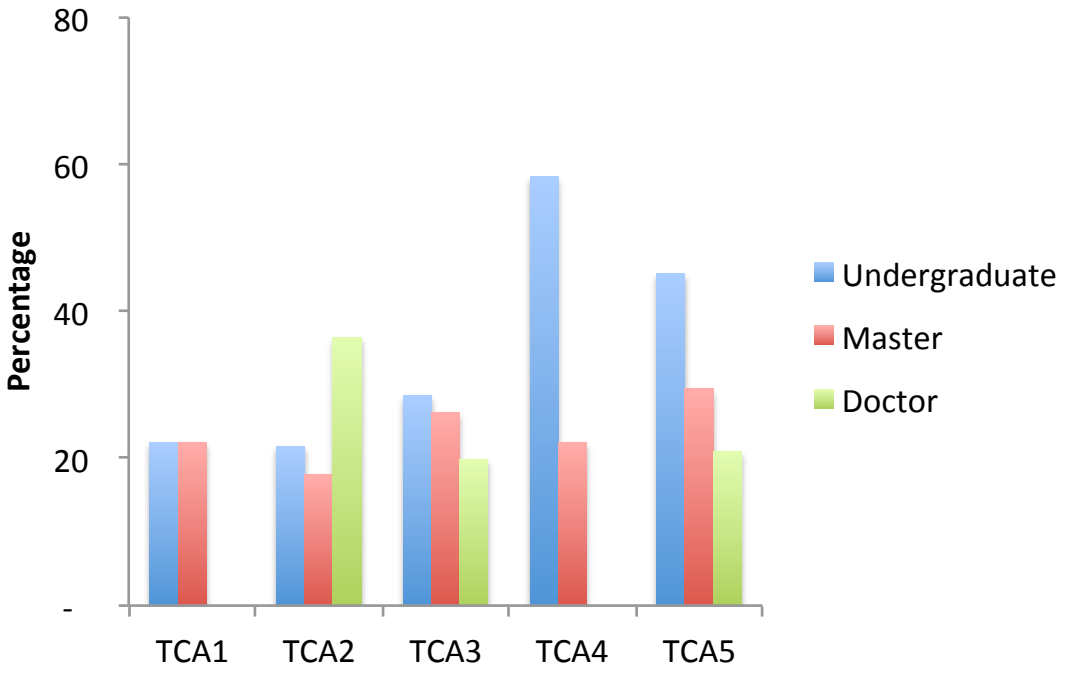

Figure 3.5. Percentage of subject content related to TCA Statistics

3.6. TCA COMMUNICATION

As previously mentioned none of the courses offered by universities or other organization conducted trainings related TCA covered communication of results. This element is very important as the achievement in the implementation of the mitigation actions and REDD+ must be reported and will be subject to verification. Reporting requirements that meet the national and international format and standards should be fulfilled. The government of Indonesia has developed guidelines and tools for facilitating the reporting and verification process, such as PEP-online and SRN. PEP-online is online system for Monitoring, Evaluation and Reporting the implementation of mitigation actions and the results. SRN (National Registry System) is an online system for registering the mitigation initiatives by the Party and Non-Party actors. The development of the curriculum for the TCA Communication must consider this system.

CHAPTER 4 CONCLUSION

There are many study programs at IPB and other universities offering courses related to six topic of the TCA instruction, particularly the ones related to TCA statistics as statistic exist in most of the study programs at IPB. The TCA topics related to Field method and IPCC guideline are found mainly in Faculty of Forestry, and Faculty of Mathematic and Natural Science, and Faculty of Agriculture. None of the courses completely covers the six TCA topics. Course related to the TCA communication does not exist in any study programs. Thus, it is concluded that Graduates from the study programs housing courses related to the TCA do not meet the competency required for professional TCA programs.

Many agencies or institutions outside university conduct training courses related to TCA instruction. Most of the training courses cover well on policy aspect of the TCA but very little on development of skills necessary for the accounting aspect of terrestrial carbon. The training program with relatively good coverage of the TCA instruction is the training program conducted by the LAMA-I. However, the duration of the training is too short and may not be enough to meet the TCA competency.

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