Technology Fact Sheet

Peat re-mapping[i]

1) Introduction

The ICCSR (Indonesia Climate Change Sectoral Roadmap) of forestry sector (BAPPENAS 2009), suggested the most feasible scenario to reach the target of reducing GHG emissions by 26% in the year of 2020 called SC3: increasing sink and creating conditions for preventing further deforestation. Most of the mitigation efforts in this scenario come from the improvement of management practices implemented on 244 newly developed FMU (forest management units) – KPH (Kesatuan Pemangkuan Hutan), in an area extent of 24 million hectares. This scenario has the lowest abatement cost per unit of emission reduction and to reduce annual GHG net emission of 800 abate to 496 MtCo2e within a time period of 2011 – 2020.

In addition, the ICCSR suggested policy oriented mitigation options for the improvement of peat management practices aimed at "low carbon" peatland management by enforcing existing legal requirement and establishing new standards of best practices. Two main mitigation options are suggested: zero burning and water management best practices to reduce annual emission of 470 MtCO2e, from 1700 MtCO2 e of BAU down to 1230 MtCO2e within a time period of 2011 – 2020.

Two methods of land resource mapping technology (in the contexts of knowledge, tools, and orgware) have been practiced to derive peat map in Indonesia: 1990 LREP (Land Resources Evaluation and Planning Project) land resources map and 1988 RePPProT (Regional Physical Planning Programme for Transmigration) land system map. The differences of knowledge underlying the mapping methods lead spatial information disagreements.

Considering that deforestation and degradation (through timber extraction) of peatland forests contribute annual emission of 0.25 Gt Co2e (DNPI 2010), a unified methodology for peat mapping is required to facilitate the availability of data and spatial information for the KPHs involved in the implementation of the mitigation scenario based on the "low carbon" peatland management policy. In other words, each newly developed KPH needs to be facilitated with a complete and updated unified peat mapping information system whose technical reliability and economic feasibility need to be demonstrated for the purpose of technology transfer and diffusion

2) Technology characteristics

Two methods of land resource mapping technology (in the contexts of knowledge, tools, and orgware) have been practiced to derive peat map in Indonesia. The first method refers to land resources mapping conducted by Land Resources Evaluation and Planning Project) – LREP (1990) and the second method refers to Land System mapping conducted by Regional Physical Planning Programme for Transmigration – RePPProT (1988). Both land resources and land system maps are represented in the same spatial scale of 1 to 250,000. The main difference of these two mapping methods lays on the entity or object of mapping and the knowledge used for mapping. The LREP method was dedicated to map land and soil resources, whereas the RePPProT were aimed to map landsystems.

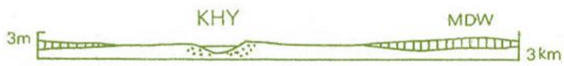
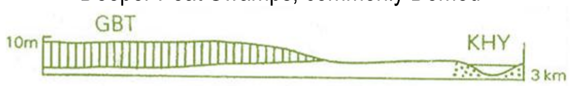
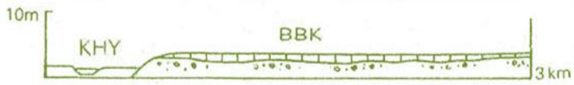
Table 1 shows how the approach of deriving peat map from LREP's land resources mapping scheme of Sumatra Island. The island is spatially mapped into 12 physiographic group of landforms. Peat map is derived from physiograpic group of Peat Domes, which are sub divided into two types of landforms euthropic and olygothrophic peat domes. Each type of peat dome landform is further sub divided into fresh water peat dome, tidal/saline peat dome, and cultivated peat dome. Finally they are classified into three classes of peat depth thin (<0.5m), medium (0.5-2.0m), and thick (>2.0m).

Table 1 Peat mapping approach derived from LREP's land resource mapping scheme

SYMBOL	PHYSIOGRAPHIC GROUP	SUB DIVISION		
A	Alluvial			
B	Marine			
D	Peat Domes 	1.Euthropic	1.Fresh 2.Tidal/Saline 3.Cultivated	1.Thin (<0.5m) 2.Med (0.5-2.0 m) 3.Thick (>2.0m)
		2.Olygothropic	1.Fresh 2.Tidal/Saline 3.Cultivated	1.Thin (<0.5m) 2.Med (0.5-2.0 m) 3.Thick (>2.0m)
H	Hilly			
I	Acid Tuff Plane			
K	Karst			
M	Mountain/Plato			
P	Plain			
Q	Toba Acid Tuff			
T	Marine terrace			
V	Volcanic			
X	Miscellaneous Landform			

A different approach of deriving peat map of Sumatra Island from RePPProT's Land System mapping scheme is presented in Table 2 The Land System mapping scheme spatially divide Sumatra Island into eleven physiographic type, each of which is further divided into landforms having similar type of landscapes with certain types of rocks, topography, climate, soil, and vegetation termed as Land Systems. Peat landform types are derived from any land system whose contains partially peat or completely peat lithologic materials. Peat domes (GBT) and seven other peat or peat containing landforms (BLW, KHY, MDW, KLR, BLI, BBK, and SLP) can be spatially delineated.

Table 2 A different approach of deriving peat map of sumatra island from RePPProT's land system mapping scheme

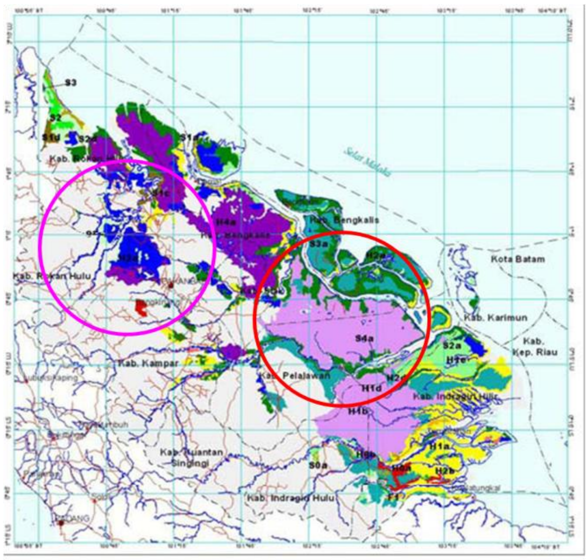
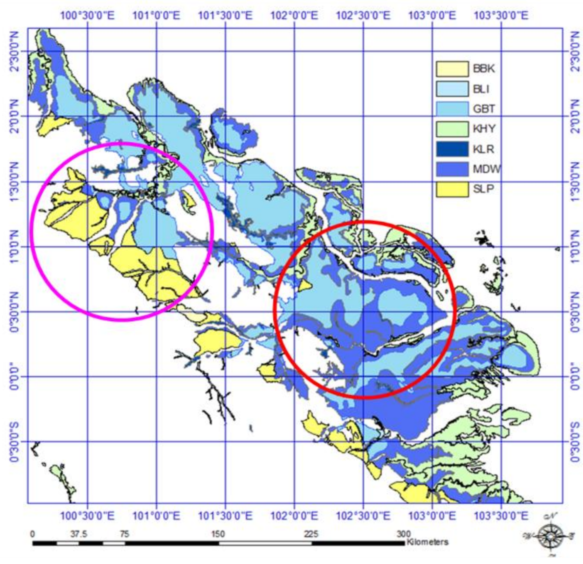
Physiographic type	LANDSYSTEMS*) Symbol	Name	PEAT LANDFORM TYPE	LITHOLOGY
Beach	**BLW**	Banjar Lawas	Peat Covered Beach Deposits 	*Peat* *Alluvium, recent marine*
Tidal Swamps				
Alluvial Plains	**KHY**	Kahayan	Coalescent Estuarine/Riverine Plains 	*Peat* *Alluvium,* *recent marine - riverine* *Alluvium, recent riverine*
Meander Belts				
Swamps	**GBT**	Gambut	Deeper Peat Swamps, commonly Domed 	*Peat*
	MDW	Mendawai	Shallower Peat Swamps 	*Peat*
	KLR	Klaru	Permanently Water Logged Peaty Floodplains 	*Peat* *Alluvium, recent riverine*
	BLI	Beliti	Swampy Floodplains of Narrow Valley 	*Peat* *Alluvium, recent riverine*
Alluvial Valeys				
Fans and Lahars				
Terraces	**BBK**	Benjah Bekasik	Low, Peat Covered Old Marine Terraces 	*Peat* *Alluvium, old clays*
	SLP	Sikladi panjang	Low, Sandy and Clayed Old Marine Terraces 	*Peat* *Alluvium, old clays* *Alluvium, old sands*
Plains				
Hills				
Mountains				

*) Landsystems are distinctive landscapes in which certain types of rocks, topography, climate, soil, and vegetation are closely interrelated. The same landscape components and properties should be found in the proportion whenever a landsystem occurs

3) Country specific applicability

Peat maps can be derived from both LREP as well as RePPProT maps. Because of differences of using knowledge underlying their mapping methods, deriving peat map from these maps lead to disagreements of spatial information. The disagreements are demonstrated in the following peat (Figure 1) maps of Riau area derived from LREP and RePPProT maps (Figure A - which can be seen in the Appendix below).

Figure 1 Disagreements are demonstrated in the following peat maps of Riau area

LREP	RePPProT
	

Observing peat maps of Figure A (which can be seen in the Appendix below) some of the disagreements are summarized as follows:

- LREP derived peat map provides spatial distribution and variability of peat depth and its degree of decomposition.
- RePPProT derived peat map provides those of land systems of peat landform types.
- LREP derived peat map does not include peat area over physiographic type terraces which can be recognized from within the magenta circles.
- RePPProT derived peat map provide more variability of peat types than that of LREP derived peat map which can be recognized from within red circles

The above listed disagreements imply that a newly innovation on peat mapping technology for remapping peatland needs to be established. This key measure could be done by:

- Synthesizing LREP methodology and RePPProT methodology
- Utilizing all of technology components resulted from previous and current R&D on peat mapping, including expertise, tools and equipments, and key players.

4) Status of technology in country

Despite the fact that the unified peat mapping system that synthesizes LREP and RePPProT mapping methodology has not been established yet in Indonesia, only recently, the initial serious efforts have been taken by DNPI (National Council of Climate Change of Indonesia) and UKP4 (Presidential Working Unit for Development Supervision and Control).

This means that the initial stage of first chain of innovation system has been established. This stage needs to be facilitated for the development of the unified peat mapping prototype, accomplishing the main target of the first chain of innovation. Whenever the first chain is completed, the second chain of innovation – technology diffusion – could be started. Again, analogous to technology A1 (Carbon measurement and monitoring), this diffusion would consider the use of and be focused on “interactive learning” approach of the key players of technology diffusion, aiming for demonstrating reliability, practicality and financial feasibility of the newly invented re-mapping technology. This process of technology diffusion of unified peat mapping should:

- Use of all available knowhow and expertise of the first chain of innovation
- Utilize the most practical, reliable, credible, and inexpensive tools (hardware) for direct as well as remotely sensed peat mapping
- Operate the most effective coordination among the key players of peat maping (i.e., BPPT, Bakosurtanal, LAPAN, Min of Forestry, Min of Environment, and Min of Agriculture).

5) Barriers

Barriers of Technology Transfer and Diffusion (TTD) for this technology is illustrated as a problem tree presented in Figure B (which can be seen in the Appendix below) of this report. It is important to note that the problem tree was defined by selecting a starter problem*: Lack reference project of viable, credible and reliable unified peat mapping reference project*. This starter problem roots from a total number of five barriers within the root zone and further propagates to four ‘canopy’ barriers through two stem barriers *weak collaborative learning* and *insufficient knowledge of and or access to proven unified peat mapping technology*.

Within the context of innovation system TTD process, root barriers correlate with maturing R&D chain and those of canopy barriers correlate with technology diffusion chain. In other words, the maturing R&D process deals with barriers to provide a *reference project of viable, credible and reliable unified peat mapping project*, whereas the chain of technology diffusion deals with barriers of adopting this technology in facilitating mitigation measures to establish a complete and updated peat mapping system to provide data and spatial information for “low Carbon” peatland management.

To assess possible solutions for overcoming barriers, a hierarchical logical framework analysis was applied to objective trees, followed by a rapid benefit cost/consequence analysis, with special consideration of critical and difficult nature of “take off” – the initial phases when the reliability, practicality and financial feasibility of the technology is demonstrated. Furthermore, the results of such assessment were used to recommend the following overcoming barrier solutions:

Table 3 Recommend the following overcoming barrier solutions for peat re-mapping

Recommended Solutions	
Maturing R&D Phase	**Technology Diffusion Phase**
Policy Action: *Establish a "National Demonstrator" project to demonstrate the reliability, practicality and financial feasibility of newly invented unified peat mapping system technology.* *Mode of Action:* *International Capacity Building for a national expert consultation working group through the development of an operational, reliable, credible, and feasible prototype of unified peat mapping system carried out on national demonstrator R&D field stations.*	*Policy Action:* *Establish a "Collaborative Learning" program for technology diffusion to transfer and operationally implement the newly invented prototyped of unified peat mapping system technology.* *Mode of Action:* *On the Job Training for personnel of KPH, HTI, HPH, and other local stakeholders carried out on national demonstrator R&D filed stations followed by a certain time period of trial and adjustment in their areas. The program is designed and implement by national expert consultation working group*

6) Benefits

The ultimate benefit GHG mitigation measures are

- annual GHG net emission of will be 800 reduced to 496 $MtCO_2e$ by implementing KPH-HTI mitigation scenario within a time period of 2011 – 2020
- annual emission of 1700 $MtCO_2$ will be reduced to 1230 $MtCO_2e$ by implementing "low carbon" peatland management (zero burning policy and water management best practice).

These ultimate benefits are not the direct benefits of carbon measurement and monitoring technology, however, they cannot be properly quantified without the establishment of a complete and updated peat mapping system supported by unified peat-mapping technology.

Further qualitative assessment of specific benefits of TTD of unified peat mapping technology suggested the followings:

Table 4 Goal: To make data and spatial information available for "Low Carbon" peatland management

Goal: *To make data and spatial information available for "Low Carbon" Peatland Management*							
Maturing R&D				**Technology Diffusion**			
Objective *Establishment of a TTD reference project of viable, credible, and reliable unified peat mapping*				Objective *To provide complete and updated information system on forest carbon stock covering sub-national level*			
Measure (M)	P	C	B	Measure (M)	P	C	B
M1. Establishment of unified peat mapping national task Force	M	L	H	M5. Establish coordination forum of relevant ministries , KPHs, and other stakeholders	M	L	H
M2. Establishment of expert working group for unified peat mapping	H	L	M	M6. Carry out on-site job training for development and implementation of unified peat mapping methods and practices	H	H	H
M3. Establish international capacity building for unified peat mapping prototype development	H	H	H	M7. Develop and implement organization mechanism to establish a unified peat mapping system covering sub national level	L	M	M
M4. Provide adequate R&D field stations and facilities for unified peat mapping prototyping (hardware and software)	H	M	H				
Notes: : P= Priority, C= Cost, B =Benefit , H= High, M= Moderate, L=Low							

7) Operations

At the national level, unified peat mapping technology needs to be maintained by Planning and Mapping unit at the Ministry of Forestry in tandem mechanism with Soil Mapping Unit of Ministry of Agriculture, supported by the expert consultation working group. Whereas at sub national and local area levels, the unified peat mapping technology need to be operated by well trained personnel of regional office of planning and mapping entities of the Ministry of forestry in tandem with those of Soil Mapping Unit of The Ministry of Agriculture. Both levels have to be well equipped with adequate tools and equipment accordingly. In other words, trained personnel and adequate tools and equipments are the hearth and prerequisite for the operations of this technology.

To maintain the operation of this technology in an optimum performance, therefore, should cover maintaining and improving personnel's knowledge and technical expertise as well as maintaining and improving supporting unified peat mapping tools and equipment. Several possible maintenance and improvement efforts are:

Establish a regular (e.g., once a year) meeting at national level as a forum of experts and technical personnel for communication and sharing experience of implementing their works. This effort will broaden knowledge and improve technical expertise of the national, local area as well as wide area unified peat mapping personnel

Maintain tools and equipment always in a ready to use condition to prevent them from fail to operate. Establish a unified peat mapping hierarchical network, i.e., national to local servicing network at local, sub national, as well as at national levels.

8) Costs

The estimation of cost of this technology faces with selecting a wide variety of options of the combination of capital costs, operations and maintenance costs, administration costs, and other costs associated with developing an enabling environment.

The list of cost estimation of this technology (low, mid, and high estimates) are as follows

Table 5 List of cost estimation of this technology

Item	Estimated Cost (USD)		
	Low	Medium	High
A. Capital costs (1 set of equipment and facilities for peat mapping) 1. Conventional peat survey and mapping equipment and facilities 2. Geodetic GPS, GPR and Multi Channel Resistivity (Geoscanner) 3. GIS, Remote Sensing, and cartographic equipment and facilities	**540,000**	**600,000**	**660,000**
B. Annual operations and maintenance cost 1. Peat survey operation cost and supplies 2. Geodetic GPS, GPR and Geoscanner operation and supplies 3. GIS, RS, and modeling operation and supplies	**27,000**	**30,000**	**33,000**
C. Annual administration costs 1. Conventional peat survey, data processing, and analysis 2. GPS, GPR, and Geoscanner Survey 3. GIS,RS, and Cartographic data processing and analysis	**22,500**	**25,000**	**27,500**
D. Annual costs for developing and enabling environment 1. National Workshops 2 times per year @15,000 2. National Seminar and Conference once per year@25,000		 **30,000** **25,000**	

9) References and Additional information

RePPProT. 1990. The Land Resources of Indonesia: A National Overview. Land Resources Department, Natural Resources Institute (NRI) of Overseas Development Administration, Foreign and Commentwealth Office, London, England and Direktorat Bina Program, Direktorat Jendral Penyiapan Pemukiman, Departemen Transmigrasi, Jakarta Indonesia

Kristijono, Agus. 2010. Mapping and Monitoring of Peat Ecosystem and Peatland: Available Knowledge and Technologies. Presentation Material, 3rd Technical Round Table on MRV Peatland Mapping: Uncertainties and Available Technologies. Natioanal Council of Climate Change (DNPI), Hotel Akmani Jakarta, Sept 20 2010

http://www.fao.org/docrep/007/y5490e/y5490e05.htm#TopOfPage
http://www.benmeadows.com/Eijkelkamp-Peat-Sampler_31220745/
http://indonetwork.co.id/MitraGunaInstrument/2478853/digital-geo-resistivity-meter-geolistrik-hp-081380328072.htm

Appendix

Figure A. Causal relation and possible probling solving in the implementing selected technologies

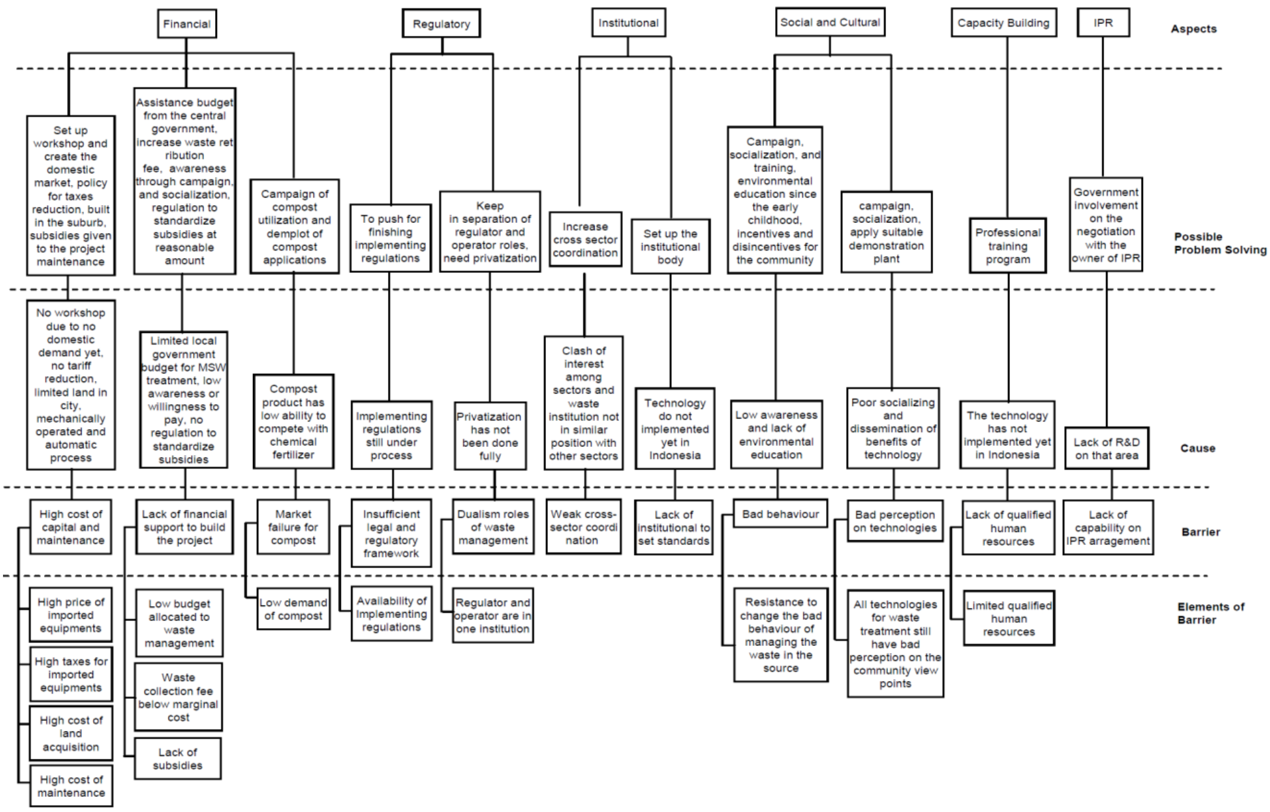
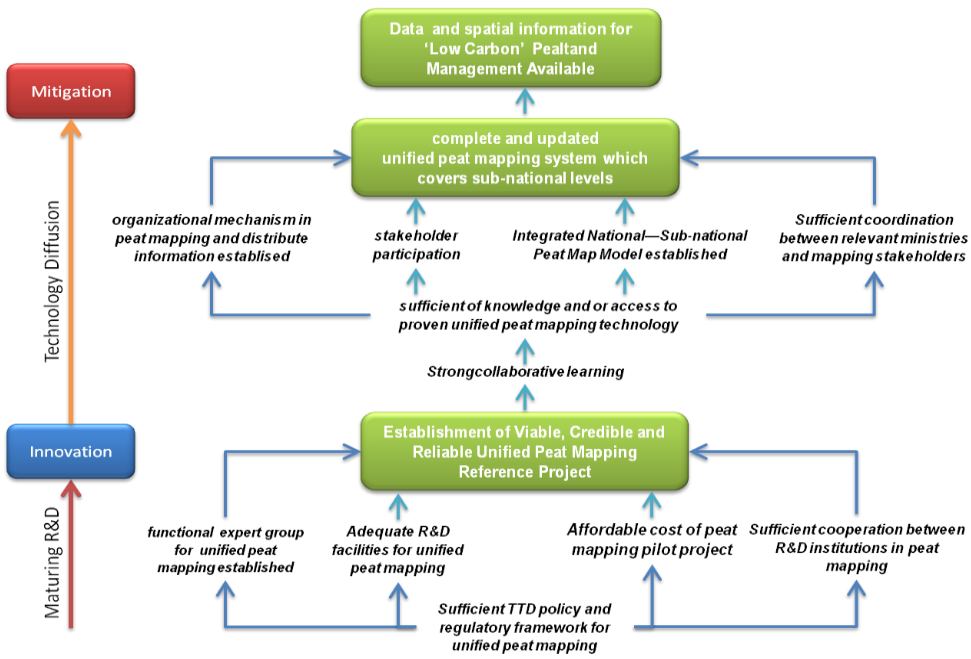


Figure B Objective tree of prioritized technology PRM



[i] **This fact sheet has been extracted from TNA Report - Mitigation for Indonesia. You can access the complete report from the TNA project website http://tech-action.org/**