ＣＤＭ植林人材育成事業

（平成１５年度実行報告書）

平成１６年３月

財団法人　国際緑化推進センター

ま え が き

「国連気候変動枠組条約締約国会議（COP)」で「クリーン開発メカニズム（ＣＤＭ)」事業として植林事業を実施するための具体的なルールが決定され、ＣＤＭ植林の推進を通じて途上国の持続可能な森林経営への取り組みを支援することが、国際協力による地球温暖化防止対策の充実を図るために緊急の課題となっている。しかし、ＣＤＭ植林の企画、実施、モニタリングなどを担うスタッフについては、途上国においても、我が国においても不足している現状にある。

「ＣＤＭ植林人材育成事業」は、このような状況に対応して、林野庁の国際林業協力事業の一環として、平成15年度から5年間の予定で（財）国際緑化推進センターが実施するもので、ＣＤＭ植林の推進を図るため、途上国及び我が国のＣＤＭ植林プロジェクト・スタッフの人材育成を行い、ＣＤＭ植林の推進を通じて、途上国の持続可能な森林経営への取り組みを支援することを目的とする。

事業の実施に当たっては、早稲田大学教授 森川 靖 博士を委員長とする「CDM 植林人材育成調査委員会」において、事業の方針や計画の策定、具体的な実施方法等について検討を行った。　本年度は、昨年１２月にイタリアで開催された「国連気候変動枠組条約第9回締約国会議（COP9)」の結果を踏まえて、「海外研修生及び国内民間企業担当者等を対象とする国内研修」を実施すると共に、CDM 植林の実施に関心の高いインドネシア国内で「CDM 植林を実施するために必要な地域の人材育成を目的とする国際ワークショップ」を開催した。

調査委員会の委員を始め、研修教材の作成やインドネシアでの研修ワークショップの講師をお願いした方々、現地での研修準備に協力いただいた関係機関の皆様には、格別のご指導・ご協力を賜り厚くお礼申し上げる。
また、本事業を実行するにあたり懇切なご指導を賜った林野庁の山田 壽夫 計画課長、同課 海外林業協力室の高木 茂 室長、海外技術班の佐藤 英章 課長補佐、及び伊奈康治技術係長の各位には深く感謝を申し上げたい。

平成１６年３月

（財）国際緑化推進センター
理事長　塚 本 隆 久

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Ⅰ．事業の概要

１．事業の背景と目的

地球温暖化防止対策を効率的に推進する「クリーン開発メカニズム（ＣＤＭ)」は、平成９年日本で開催された「国連気候変動枠組条約 第３回締約国会議(COP 3)」で採択された「京都議定書」によって設立されたが、その制度を実施するための具体的なルール作りが遅れていた。 しかし、平成13年のCOP 7において、「このCDM制度に吸収源ＣＤＭ事業（新規植林）を含める」ことが合意され、さらに平成15年12月にイタリアのミラノで開催されたCOP 9では「吸収源ＣＤＭ植林事業の具体的な実施手続・要件等が決定」され、この事業を実施する国際的な条件が着々と整ってきた。

このような状況のもとで、多くの開発途上国では「温暖化対策としてのＣＤＭ植林を自国の持続可能な森林造成事業として活用したい」意向を有している。 しかし、ＣＤＭ植林の企画、実施、モニタリングなどを担うスタッフが不足しており、ＣＤＭ植林プロジェクト・スタッフの育成を求めている。また、国内でも、平成１４年３月に決定された「地球温暖化対策推進大綱」で「ＣＤＭへの民間事業者等による取組を推進するため、人材育成を行う」とされており、ＣＤＭ植林プロジェクト実施のためのスタッフ育成が国内的にも急務となっている。

このため、本事業では、ＣＤＭ植林の推進を図るため、途上国及び我が国のＣＤＭ植林プロジェクト・スタッフの人材育成を行い、ＣＤＭ植林の推進を通じて、途上国の持続可能な森林経営への取り組みを支援することを目的とする。

２．実施計画の検討

１)「ＣＤＭ植林人材育成調査委員会」の設置

この事業の効果的な実施を図るため、海外植林、森林の炭素吸収及び人材育成等に関する学識経験者からなる「ＣＤＭ植林人材育成調査委員会」を設置し、平成１５年６月３０日に第一回委員会を開催した。 この委員会では、委員長に早稲田大学教授の森川 靖氏を、副委員長には当センター主任研究員の森 徳典氏を選出した。第一回の委員会では、次の９名からなる委員会を設置すると共に、事業の年度計画等の検討を行った。

名 称 ： 平成１５年度「ＣＤＭ植林人材育成調査委員会」

構 成 ：

委員長	森川 靖	早稲田大学人間科学部 教授
副委員長	森 徳典	国際緑化推進センター 主任研究員
委員	天野 正博	早稲田大学人間科学部 教授
委員	大角 泰夫	国際緑化推進センター 主任研究員
委員	清野 嘉之	森林総合研究所 森林植生研究領域長
委員	小島 克己	東京大学アジア生物資源環境研究センター 助教授
委員	二宮 康司	地球環境戦略機構(IGES) 気候政策ﾌﾟﾛｼﾞｪｸﾄ研究員
委員	横田 康裕	森林総合研究所 東北支所
委員	吉川 賢	岡山大学農学部 教授

２）第１回委員会（平成１５年６月３０日開催）

第１回委員会では、上記のように委員構成を行った後、事業の目的・概要、ＣＯＰの日程・内容、この事業と他の関連事業との連携のあり方等の検討に基づいて、人材育成事業の方針、実施計画等の基本的事項について審議した。この結果、研修の対象者、カリキュラムなど、研修の基本方針について、次の（1）～（8）の方向で合意に達し、表1，表2に示す暫定的な全体及び年間計画（案）が承認された。

（1）研修の対象者については、CDM 植林をより効率的に推進する観点から、少なくとも初年度の段階では、日本人スタッフ、ホスト国スタッフともに、CDM 植林プロジェクトの企画立案を担う中堅幹部とすることが望ましい。

（2）研修プログラムについては、正味３日間程度の短期集中コースとし、その中で、植林が CDM 植林事業としての認証を受けるために満たすべき基準、事業計画・実施にあたって具体的に配慮すべき点などを中心に講義することが望ましい。

（3）従って、研修科目についても、一般的植林事業の企画立案という視点でなく、CDM 植林事業として、有効化（validation)、検証（verification）を行うために必要な内容に重点を置く方向で構成を検討する必要がある。

（4）海外におけるセミナーについては、CDM 植林事業受入れ見込み国で行うこととし、初年度はインドネシアで年度末の開催を予定する。なお、セミナーの具体的な内容・講師・参加対象（研修生）等については、８月にインドネシアに事前調査チームを派遣し、相手方の意向を聴取した上で、再度検討する。

（5）研修教材については、COP における吸収源 CDM に関する細部ルールの決定、OE による排出削減案件の審査等、諸般の状況の進展に応じて、逐次拡充していくことになるが、初年度については、まず、排出削減 CDM に関するルールを学べるような教材を準備する。または、COP9 終了次第、その成果を織り込んだ吸収源 CDM に関する教材を作成する。

（6）研修講師については、上記の教材を解説する講師に加えて、CDM 植林を円滑に推進するため、ホスト国における地域住民との関係を学ぶ目的で、ホスト国の NGO 幹部などを講師として招くことも（ホスト国の了解が得られれば）検討に値する。

（7）研修プログラム、教材、講師、日程などの検討は、事務局と関係委員が修正案を作成次第、メール等を通じて全委員に連絡し、意見調整を図って決定する。

（8）次回の委員会は、研修実施前の、来年１月を目途に開催する。

表１．　事業全体（５カ年）の作業スケジュール（暫定案）

年度（平成） （西暦）	15 (2003)	16 (2004)	17 (2005)	18 (2006)	19 (2007)
① CDM 関連資料の収集・分析	←―――	―――	―――	―――	―――→
② CDM植林人材育成研修にかかる 研修計画、教材資料の検討・作成・改訂	←―――	―――	―――	―――	→
③ 現地準備打合せ調査 （海外研修の対象者、林分、内容の事前調整）	←―――	―――	―――	―――→	
1)アジア・大洋州地域	←→	←→			
2)ラテンアメリカ地域			←→		
3)アフリカ地域				←→	
④ 海外研修	←―――	―――	―――	―――	―――→
1)アジア・大洋州地域	←―――	―――	―――	→	
2)ラテンアメリカ地域			←―――	―――→	
3)アフリカ地域				←―――	―――→
⑤ 国内研修	←→	←→	←→	←→	

表２．　平成 15 年度の作業スケジュール（暫定案）

項目	平成 15 年（2003）							平成 16 年（2004）		
	6月	7月	8月	9月	10月	11月	12月	1月	2月	3月
① 総合調整委員会	▲									▲
② 人材育成事業委員会	▲							▲		
③ CDM 関連資料の収集・分析、研修教材等の作成	←―	――	――	――	――	――	――	――	―→	
④ 海外研修（アジア地域）										
現地準備打合せ調査			←→		←→					
研修生の選考等					←―	――	―→			
海外研修の実施										←→
⑤ 国内研修										
研修生の選考等					←―	――	―→			
国内研修の実施								←―	―→	
⑥ 収集資料取りまとめ、及び報告書作成									←―	―→

３）第２回委員会（平成１６年１月２７日開催）

本年度２回目の委員会では、１２月に開催されたＣＯＰ９の結果等、CDM を巡る最新の情勢について情報交換した後、今年度の事業の進捗状況、今後予定される国内・国外における研修カリキュラムなど、研修の実施方針、来年度以降の事業の進め方などについて、次のような審議が行われ、委員会としての研修実施に関する基本的な方針が示された。

（１）国内研修については、日本人とホスト国スタッフを合同で研修することが計画されているが、内外どちらの研修生に重点を置くかによって、講義内容が微妙に異なるのではないか？ また、国内スタッフに対し、英語のみによる講義で支障ないのか？

（2）ＣＤＭ関係では、国際会議で定義され、和訳が確定していない特殊用語が多いこと、また、ホスト国との交渉など CDM 植林事業の担当者には英語による説明能力も重要であることなどから、研修教材を英語で作製し、内外スタッフ合同の研修を試行することで了解する。来年度以降の実施方法は、今年度の実施結果を見て判断する。

（3）講義内容については、国内スタッフに重点を置いて考える。また、講義方法については、ホスト国スタッフに配慮し、英文教材を使い、原則として英語で説明するが、理解が困難な部分は、適宜日本語で補足することにより国内スタッフの理解を助ける。

（4）海外におけるセミナーは、今年度インドネシアのスマトラ島で実施することで了解。なお、来年度以降の実施国・地域については、各国の京都議定書の批准、吸収源ＣＤＭのホスト国となる可能性などを考慮しながら、早めに検討する。

（5）研修教材については、２月初めまでに最終的な調整を完了する目標で作業を進める。また、吸収源 CDM の実施に関するルールは、一般人にとって極めて難解であるので、いきなりその説明をしても理解されないおそれがある。今後 AR-ＣＤＭ事業を推進するには、この事業に対する正しい理解を広く普及していくことも重要である。このため、一般向けに分かりやすく吸収源 CDM を解説した小冊子ができれば望ましい。

（6）海外におけるセミナーには、森川委員長等が出席し、講演を行う。また、国内の研修については、教材執筆委員等が講師として参加する。 事務局は、林野庁および関係委員等と連携し、内外の研修対象者の募集・選考を的確に行う。

Ⅱ．15 年度事業結果(国内における研修)

１．研修カリキュラムと教材

第１回委員会の検討結果に基づき、関係委員等との調整を経て、３日間の研修カリキュラム案が作成された。原則として各科目の講師に教材の作成依頼を進めるとともに、１２月に開催されたＣＯＰ９の結果等を踏まえた内容になるよう修正を行った。
この結果は、１月開催の第２回委員会で了承され、２月２４日から２６日まで、都内のホテル会議室において、国内研修会が実施されることとなった。国内研修のカリキュラムは次ページの通り、また、教材（概要）は、資料１（３１ページ）の通りである。

表3． 国内研修カリキュラム

CDM植林人材育成事業　国内研修カリキュラム

Curriculum of AR-CDM Capacity Building Program in Japan

実施時期：２月２４－２６日　　　会場：ホテルエドモント（飯田橋）

From February 24 to 26, 2004　　　Venue: Hotel Metropolitan Edomont in Iidabashi, Tokyo

	第１日：２月２４日（火） Tuesday, February 24	第２日：２月２５日（水） Wednesday, February 25	第３日：２月２６日（木） Thursday, February 26
会議室	春　琴(Syun Kin Room)	はなぶさ(Hana Busa Room)	はなぶさ(Hana Busa Room)
9:30～	オリエンテーション(事務局) Registration & Orientation		
10:00～	開講式 Opening Ceremony		
10:15 ～ 12:15	1. 地球温暖化の動向と対策 Present status on Global Warming 2. 京都議定書とCDM制度 CDM issues in the Forest Sector	5. COP9で決定された吸収源CDMに関するルールと吸収源CDMﾌﾟﾛｼﾞｪｸﾄ特有の課題 Definitions and Modalities for AR-CDM (Rules decided in COP9)	8. 吸収源CDMﾌﾟﾛｼﾞｪｸﾄ実施上の問題点に関するホスト候補国参加者との意見交換 Free Discussions between participants from candidate host countries of AR-CDM and Japanese participants
	（早稲田大 天野氏） Prof. Masahiro AMANO, Waseda University	（林野庁 海外協力室 佐藤氏） Mr. Eisho SATO, Office of International Forestry Cooperation, Forestry Agency, Min. of Agr., Forestry & Fisher.	（JIFPRO 森 主任研究員） Dr. Tokunori MORI, Japan International Forestry Promotion & Cooperation Center
	昼休み Lunch Break	昼休み Lunch Break	昼休み Lunch Break
13:30 ～ 15:00	3. 排出量削減CDM制度 Modalities and Procedures of CDM in General	6. 吸収源CDMプロジェクト設計書（PDD）の概要 (1)吸収源CDMのﾌﾟﾛｼﾞｪｸﾄｻｲｸﾙ Project Cycle of Sink CDM (2)吸収源CDMのPDD Project Design of Sink CDM	**14:00~17:00** JIFPRO主催の CDM国際フォーラム に参加 Join the International Forum on AR-CDM held by JIFPRO in the same hotel
	（IGES二宮氏） Mr. Yasushi NINOMIYA, Institute for Global Environmental Strategies	（パシフィックコンサルタンツ、逸見氏） Mr. Tatsushi HEMMI, Pacific Consultants Co., LTD.	
	休　憩 Coffee Break	休　憩 Coffee Break	
15:15 ～ 16:45	4. 排出量削減CDM制度の事例 Case Study & others	7. 吸収源CDMプロジェクト評価の視点 (1)吸収源CDM参入者の関心事 Interests of Project Participants (2)吸収源CDMの技術的側面 Technical Aspects of Sink CDM	
	（IGES二宮氏） Mr. Yasushi NINOMIYA, Institute for Global Environmental Strategies	（パシフィックコンサルタンツ、逸見氏） Mr. Tatsushi HEMMI, Pacific Consultants Co., LTD	

２．研修参加者と研修結果の評価

１）研修生の募集・選考

国内の研修生については、当センターのホームページを利用するなどの方法によって、一般公募を行った。本年度は、ＣＯＰ９直後の研修実施であり、公募期間も短く、また、この事業の趣旨もあまり理解されていなかったためか、応募状況はやや低調であったが、応募者のなかから１１名が選考された。国内研修生の名簿は次ページの通りであり、その内訳をみると、民間企業から５名、公益法人等から３名、国際協力銀行から２名、大学から１名の参加であった。

海外からの研修生については、第１回委員会における審議の趣旨に沿ってＣＤＭ植林事業ホスト国の候補と目される数カ国から招聘することとし、当センターが協力関係にある各国機関を通じて、適切な人材の推薦を受け、最終的に次ページ名簿の５名を選考した。今年度の国別内訳は、インドネシア３名、ベトナム、ミャンマー各１名であった。

２）研修成果に関する評価

なお、海外研修生には、研修３日目のカリキュラムとして、各国におけるＣＤＭ植林に関するこれまでの取り組み状況など、将来の吸収源ＣＤＭプロジェクト実施に係わる問題点について、それぞれ自国の現状を発表していただき、国内参加者との意見交換を行った。その際用いられた、海外ホスト候補国の現状等は資料２（９１ページ）のとおりである。

また、研修終了後、国内・外からの研修参加者を対象に研修に関する評価アンケートを実施した。その結果は、資料４（９ページ）のとおりである。回答者（１３名）全員がこの研修が有用であったと評価しており、吸収源ＣＤＭに関する知識が、それぞれの経歴・背景に基づき、各研修生なりに整理・理解されたものと思われる。

吸収源ＣＤＭの実施ルールについては、なお細部に若干曖昧な部分が残されている上、吸収源ＣＤＭの実施例が未だ皆無であるため、研修生に具体的なイメージをつかんでもらうことが現段階では大変困難であった。このような点については、排出源 CDM 事業の事例を利用して、さらに実務的な内容を充実する必要があると思われた。なお、大半の者がＣＤＭ植林事業を推進するには、日本、ホスト国など関係機関の強力かつ継続的な支援が必要であると回答している。

表４．研修参加者名簿(参加確認順)

研修参加者(参加確認順)　List of Participants (in order of confirmation)

海外：Overseas

①Dr. A. Jisbar; INKOPTEK TANHUN, Indonesia
社会林業・技術開発地域振興協同組合中央会 副会長

②Dr. K. Ginoga; Center for Socio-Economic Research on Forestry (CESERF), Indonesia
林業経済研究所上席研究員

③Mr. B. Zainal; Forestry Department of West Nusa Tengara Province, Indonesia
西ヌサテンガラ森林局長

④Mr. B. C. Nghia; Forestry Basic Inventory Division, Forestry Department, Vietnam
農業・地域開発省林業開発局計画官

⑤Mr. U M. Aung; Forestry Training Center, Forestry Department, Myanmar
林業省森林局研修所長

国内：Domestic

①Mr. C. TANNO; Mitsubishi Corporation
三菱商事株式会社 資材本部 チップ・植林ユニット

②Mr. T. FUKUSHIMA; University of Tokyo
東京大学農学部、林政学研究室

③Ms. M. YAMADA; Japan Overseas Plantation Center for Pulpwood
海外産業植林センター

④Mr. I. NAKAGAWA; Kansai Environmental Engineering Center Co., Ltd
㈱関西総合環境センター 環境評価部

⑤Mr. K. KANEDA; Ohji Paper Co., Ltd
王子製紙株式会社 原材料本部　植林部

⑥Mr. H. IKEGAWA; Japan Forest Engineering Consultants (JFEC)
林業土木コンサルタンツ

⑦Mr. S. TANABE; Japan Forest Technical Association
日本林業技術協会

⑧Mr. H. MURAOKA; Japan Bank for International Cooperation
国際協力銀行 環境審査室

⑨Mr. T. KIKUKAWA; Japan Bank for International Cooperation
国際協力銀行 電力エコノミスト

⑩Mr. S. FUJIOKA; The Kansai Electric Power Company, INC.
関西電力株式会社　環境室　環境企画グループ

⑪Mr. H. TAKAHASHI; Ohji Forest&Products Co., Ltd
王子木材緑化株式会社　林業部

資料４． CDM 人材育成国内研修　評価アンケートの結果

Questionnaire for evaluation by participants（質問票の様式）

To improve this CDM course, your kind cooperation would be highly appreciated in answering the following questionnaires.
（研修内容の改善のため以下の問いにお答え願います。）

Q1. Do you think, from general point of view, that the Course will be of some help to the capacity building regarding AR-CDM in your country?　(　Yes　,　No　)
（問１．この研修は全体として CDM 人材育成に役立つと思いますか？　その訳は？）

Q2. Which part of the course was most informative/ helpful to you?　And why?
（問２．研修内容のうち最も有意義だったのはどの部分ですか？　その理由は？）

Q3. Which part of the course was most difficult for you to understand?　And why?
（問３．研修内容のうち最も難解だったのはどの部分ですか？　その理由は？）

Q4. Do you have any suggestions to improve anything of this course?
（問４．研修をより良くするために何かご意見がありましたらご記入下さい。）

Q5. What, do you think, should be done to promote the AR-CDM projects?
（問５．吸収源 CDM を促進するには、何が必要だと思われますか？）

回答者　A

1．役立った。
講義の内容については大概知っていたものだったが、講師との質疑応答から得られたものが大きかった。

2．講師との質疑応答が役立った。

3．英語での講義はついていくのが難しかったが、英語で話すのはもっと難しかった。

4．それぞれの講師の講義内容にオーバーラップした部分があったことが残念。

5．(日本？）政府はもっとＡＲ-ＣＤＭの推進に力を注ぐべき。

回答者　B

1. 役立った。
一人でＡＲ－ＣＤＭについて学ぶのはとても難しいので、この研修は大いに役立った。ＡＲ－ＣＤＭについてのいろいろな課題が要約されていたのが、特に有用だった。

2．B講師とD講師の講義
ＣＤＭプロジェクトの詳細と、すでに決定されている事柄とそうでない事柄がはっきりして役立った。

3．ＣＥＲクレジットについてその有効期間や繰越等の事柄がわかり難かった。

4．日本人の参加者の少ない理由は講義が英語だったからだと思う。

5．ホスト国と投資国の得る便益を明確にすること。

回答者　C

1．役立った。
研修証書のようなものがあったほうが良いかどうか（？）。

2．C講師の講義
吸収源ＣＤＭに直接に関連したものだったので。

3．自分の専門分野外だったので、B講師の講義は難しかった。

4．＊研修証書の発行　＊参加者に年齢制限（５５－６０歳以下）をつける
＊研修目的を更に明確化する。

5．＊簡易化　＊追加性にかかる規定の緩和　＊経費の低減

回答者　D

1．役立った。

ＡＲ－ＣＤＭの実施ルールについての基礎知識を得ることができた。

2．C 講師の講義

事業参加者のリスクとは何かについての基礎知識などが明確になった。

3．C 講師の講義

ＣＯＰ９で決定されたことや日本政府の対応に曖昧なところがあって、混乱。

4．＊ＣＤＭの基礎的知識に関する講義を短くし、すでにＣＤＭ事業を手がけている参加者を多くして、ＣＤＭ事業に焦点を絞る。

＊　ＣＯＰ９で決定された事項に焦点を絞って、それらを明確に説明する。

＊　講師の考えをさらに明確にする。

＊　AR-CDMのＰＤＤの作成方法について、ケース・スタディをもとに説明する。

＊　ＣＯＰ９の決定事項や日本政府の政策に照らし合わせて、ＡＲ－ＣＤＭ事業参加者がこうむる或いは享受するメリットやディメリットに焦点をおく。

5．＊潜在的ＡＲ－ＣＤＭプロジェクトの類型リストを準備する

＊(日本政府が日本の)プロジェクト参加者へのインセンティブを高める

回答者　E

1．役立った。

導入から現在にいたるまでのＣＤＭに関する決定事項等が網羅されていて、ＣＤＭの初心者にはとてもよいコース内容。

2．A 講師の講義（温暖化とＣＤＭ制度の概要について）が最も役に立った。

3．B 講師の講義（排出量削減ＣＤＭの事例）はやや難解だった。

4．プレゼンテーションに使われたスライドや内容は良かった。講師の経歴等がまちまちだった。講師同士がお互いの考えを確認しあえるチャンスがあると良かった。

5．ＡＲ－ＣＤＭについてのセミナーや討論会を地域レベルでもっと実施する。たとえばシンカラ湖（西スマトラ）で研修を行う。

回答者　F

1．役立った。

　＊ＣＤＭは人の生活に関与する天然資源や環境問題に深く関係している。

　＊ＣＤＭは我々の抱える問題を地域的及び世界的スケールで解決しようとする新たなアイディアである。

2．森林に関するＣＤＭについての課題。

3．ＣＤＭにかかるルールと手続き。
関与するする範囲が広大で、ＣＤＭがうまく実行できるとは思えない。

4．ＣＤＭに興味を持つような企業にそのコンセプトをよりよく理解してもらい、ＣＤＭコンセプトをそれ企業の事業に反映できるようにする。

5．できるだけ早く規則を確定して、地域の実態にあったモデル事業を実施する。

回答者　G

1．役立った。
ＣＯＰ９で決定された事柄にそって、ＣＤＭ事業を実施するためのステップが詳しく説明されて有用だった。

2．講師は全員良かった。
特にＣ講師はＣＥＲの取り扱い方についての考え方を詳しく説明してくれた。

3．Ｄ講師の講義
複数の例を上げてベースライン・シナリオについて説明してくれたが、かえって、わかり難かった。

4．次の内容を盛り込んだ講義増やす。

　＊ＰＤＤの作成経費の削減化に寄与するような講義

　＊ＣＤＭ事業への投資誘致方法

　＊“ＣＥＲへの支払い”の方法

5．＊ＣＤＭ事業を可能にできるようホスト国側が十分な準備を行う、たとえば、ＣＤＭに係るＣ＆Ｉの整備を早急におこなって。

　＊　今回の研修のようなキャパシティー・ビルディンを数多く実施する。

回答者　H

1．役立った。
帰国後、森林局上司に報告する。

2．A講師
地球温暖化の現況について

3．B講師
ＣＤＭに係る実施ルールや手続きの概要自体が理解しにくい。

4．研修日程が短い。
初心者にはもっと時間をかけた研修が欲しい。

5．ホスト国でも今回のような研修を実施する。

回答者　I

1．役立った。
ＣＤＭに関する知識をいっぱいつめこまれて、ＡＲ－ＣＤＭに関するルールを把握できた。

2．ＡＲ－ＣＤＭにかかる定義と実施ルール。
ルールがとても複雑で、理解しにくい部分だったが、講義を受けて理解できるようになった。

3．吸収源ＣＤＭのＰＤＤ。
ＡＲ－ＣＤＭのＰＤＤに関してはまだ、詳細が決定されていないこと、誰も実際にＡＲ－ＣＤＭ事業を実施したことがないので、内容の把握は難しい。

4．ケース・スタディ(たとえばＡＲ－ＣＤＭ事業をベトナムで実施して)を通して、学ぶ。
実施する過程で検討をしながらＡＲ－ＣＤＭ事業につての理解を深める。

5．ＡＲ－ＣＤＭ事業は、排出削減にかかる事業より困難な点が多いと思う。
日本政府は６％のＣＯ２削減目標の難しさを国民によりよく説明すべき。

回答者　Ｊ

１．役立った。
　　海外の関係者から話を聞く機会が得られた点が良かった。

２．各コースが個別の問題をとりあげていたので、体系的な理解を深めるのに役立った。

３．吸収源ＣＤＭの追加性について海外の研修生には難解？

４．受講者が教材を事前に読んだ上でコースを進める方法も検討したらどうか？
　　例えば代々木のオリンピックセンターに泊まり込みで実施するのも一案。

５．(1)　日本国政府の全面的な支援が必要（途上国での所有概念が不安、森林資産が保全される保証が必要)。
　　(2)　日本国内における制度整備、ＣＤＭ／ＪＩとも、ホスト国との窓口設置（ＤＮＡ？）が早期になされるよう強く望む。

回答者　Ｋ

１．役立った。
　　吸収源ＣＤＭに関する知識をこれまで余り共有できていなかったと思うので。

２．排出量削減ＣＤＭについての解説、吸収源ＣＤＭの企画・形成、ともに分かりやすい説明だった。

３．吸収源ＣＤＭ評価の視点については、概論のみで具体的な内容の把握は難しかった。

４．ＣＤＭ評価の視点については、具体的にＰＤＤを何ケースか例示して、方法論、ベースライン等、良い評価のものと却下されたものを比較して解説して欲しい。

５．途上国が得たＣＥＲをクレジットとして売れるような具体的なルールが必要。

回答者　L

1．役立った。
ＡＲ－ＣＤＭを理解するという点では非常に役立ったが、実行ということになると、もう少し勉強（理解）が必要。

2．吸収源ＣＤＭに関するルール、課題については、複雑で、これまでなかなか理解できないでいたが、少し分かったような気がする。

3．吸収源ＣＤＭに関するルールの存在は分かったが、ｔ－ＣＥＲ、ｌ－ＣＥＲの有効期限などのしくみが複雑で、今ひとつ理解できない。

4．このような研修会をもっと開催して欲しい。

5．ＡＲ－ＣＤＭは、基本的に商業植林の参加を拒否しているように感じるが、もう少しルールを緩やかにし、参加しやすいものにすべきではないか。

回答者　M

1．　役立った。
ＣＯＰ９以後の情報を第一人者により解説いただき、有意義であった。

2．　問１と同じ。

3．　ベースラインに関する３つのオプションについて、ＡＲ－ＣＤＭの例で想定される事例での説明が不足しており、イメージがつかめなかった。

4．　ケース・スタディのような、実際の事例に近いものを使用した説明が得られたら良いと思う。

5．　？

Ⅲ．15年度事業結果(海外における研修)

1．インドネシア人材育成ワークショップの概要

今年度の海外研修事業については、第１回委員会の方針に沿って、インドネシア林業省など関係機関と事前打合せを行ったうえ、その結果を第２回委員会に諮り、平成16年３月１３～１４日に、インドネシア国西スマトラ州ブキティンギ市で行うこととした。その概要は次の通りである。

１）出張者及び日程

（１）出張者

森川　靖	早稲田大学　人間科学部　教授
大角　泰夫	国際緑化推進センター　主任研究員（技術顧問）
林　久晴	国際緑化推進センター　専務理事
長塚　耀一	国際緑化推進センター　理事・企画部長
高橋　美喜子	国際緑化推進センター　総務部
村田　美代子	国際緑化推進センター　総務部

Nguyen Viet Khoa	ベトナム国農業地域開発省林業局森林専門官
Dr. Wuthipol Hoamungkaew	タイ国カセサート大学林学部森林経営学科講師
Engr. Santiago R. Baconguis	フィリピン国森林生態系研究所主任研究官

(なお、Khoa氏以外の２名は直前に連絡があり、ジャワ島Bogorでの他行事のみ参加)

（２）日　程

3月11日(木):11:05成田発JL715（ジャカルタ16:50着）

3月12日(金): 9:55ジャカルタ発GA162（パダン11:30着）
ブキティンギへの移動（車で約２時間）
夕刻; 来賓、講師等と事務局の事前打合せ

3月13日(土): 国際ワークショップ
「CDM吸収源事業実施のための地域における能力開発」の開催。

3月14日(日): AR-CDMプロジェクト（CDM植林事業）実施候補地の視察

3月15日(月): ブキティンギからパダンに移動（車で２時間）。
12:10パダン発GA163（ジャカルタ13:45着）
23:50ジャカルタ発JL716（ 成田着１６日（火）8:40 ）

2） ワークショップの内容と資料

「CDM 吸収源プロジェクト実施のための地域における能力開発」に関する国際ワークショップの概要は下記の通りである。西スマトラ州ブキティンギ市において、約８０名が参加し、人材の育成等など、インドネシア、特にスマトラ地域において CDM 吸収源プロジェクトを推進するための方策について、１日の講演・討議と、翌日の現地視察を行った。また、その際、配布された資料は１１１ページの資料３のとおりである。

目的：

1. CDM 吸収源プロジェクト実施のための地域関係者の能力開発。
2. 地域関係者の CDM 吸収源プロジェクト計画書作成に関する知識の向上。
3. 西スマトラ州における CDM 吸収源プロジェクト実施可能性の検討。
4. 慣行/入会地の CDM 吸収源プロジェクトへの活用可能性の検討。

日時、場所：

２００４年 3月１３－１４日、西スマトラ州 Bukittinggi、Hotel Novotel-Coralia

第１日はワークショップ、２日目はﾌﾟﾛｼﾞｪｸﾄ候補地、Singkarak 湖畔のせき悪地を視察。

日程：

08.30 - 09.00	登録	
09.00 -09.45	開会あいさつ	Bukittinggi 市長 歓迎の挨拶 JIFPRO 林 専務 あいさつ 西スマトラ州知事 開会の辞（代理）
09.45-10.00	休憩	

第１部：モデレイター Dr. Hermansah (Andalas University)

10.00-10.20 「西スマトラ州における CDM 吸収源プロジェクト実施の可能性」
西スマトラ営林局長 Ir. Johny Azwar

10.20-10.40 「慣行/入会地の現況とその吸収源プロジェクトへの活用可能性」
ミナンカバウ地域協議会 幹事 H. Kamardi Rais

10.40-11.00 「西ジャワのマンギウム、メルクシマツ、ラワンの炭素固定」
森林環境研究所長 Dr. Fauzi A. Masu'd

11.00-11.20 「森林の環境機能と植林の新たな財源」 ソロ地区 区長 H. Gamawan Fauzi

11.20-11.40「CDM 植林－JIFPRO のロンボク島での経験から」JIFPRO 主任研究員 大角泰夫

11.40-12.40 意見交換

12.40-13.40 昼食

第2部：モデレイター ***Dr. Upik Rosalina (Bogor Agriculture University)***

13.40-14.00「シンハラ湖集水域におけるプレ CDM 吸収源プロジェクトと貧困撲滅の可能性」
社会林業・技術開発地域振興協同組合中央会 Dr. Alimin Djisbar

14.00-14.20「CDM 植林における炭素測定技術」 森林環境研究所 Dr. Ngaloken Gintings

14.20-14.40「人工林による炭素固定と AR-CDM」 早稲田大学教授 森川 靖

14.40-15.05「CDM 事業期間と CDM 吸収源プロジェクト提案書の作成」
ボゴール農科大 Dr. Ir. Rizaldi Boer

15.05-15.45 意見交換

15.45-16.00 総括 Ir. Zuwendra (組織委)

閉会の辞 Bukittinggi 市長

2．ワークショップの成果

1）参加者及び会議総括

ワークショップの実際の参加者は20ページのとおり８６名であり、当センターの講師、インドネシア国内で CDM 植林推進の中心となっている研究者、政府機関職員、さらには地元の林業関係者などの講演、参加者との質疑応答など、数時間にわたる会議ののち、２４ページ、資料５のような会議総括を行って閉会した。

会場でのやりとりからは、参加者間の CDM 植林に関する知識に大きな差が見られた。そのため、このワークショップが全体として地域にもたらす成果（CDM 事業推進効果）も多様と思われる。このなかで吸収源 CDM 制度に関する知識の如何に拘わらず、共通的な意見として、今後途上国の人材育成で期待される２つの方向が明らかになった。

ひとつは、このような人材育成プログラムを、事業の直接的な利害関係者である植林対象地域住民を対象として実施し、関係住民の意欲を高め、参画型の事業形成が円滑に行える基盤をつくることが、CDM 植林の実施には不可欠と思われる。

また、地域住民などの関係者に CDM 植林の実効性を訴えるには、早急に、小規模な CDM 植林モデル事業（パイロット CDM 植林）を実施して、この制度の実施可能性を具体的に示しつつ、本格的な事業に要する現地国の人材を実際の作業から OJT で育成することが最も有効かつ実践的な手段ではないかという見解である。

2）地元紙による報道

このワークショップについては、地域の関心も高く、２５－２９ページ、資料６－７のような記事（インドネシア側による英語翻訳）をはじめ、多数の地元紙による報道が行われた。

3）CDM 候補地の視察

ワークショップの翌日には、会場から2時間ほどの距離にあるシンカラッ（Singkarak）湖周辺地域の CDM 植林事業候補地を訪問した。現地は下記の写真のように、集落の上部に広がる傾斜地荒廃草原であり、部分的に灌木や間作地が混交している。土地の所有関係は旧慣集落共有林で、住民が共同で細々と植林を行い、重要な水源湖の流域保全に努めているが、上部の国有保安林も含め数千ヘクタールの荒廃地の回復には CDM 植林を活用した本格的な造林事業が必要不可欠と考えられる。

写真1．　ワークショップ参加者が現地視察した CDM 植林候補地域

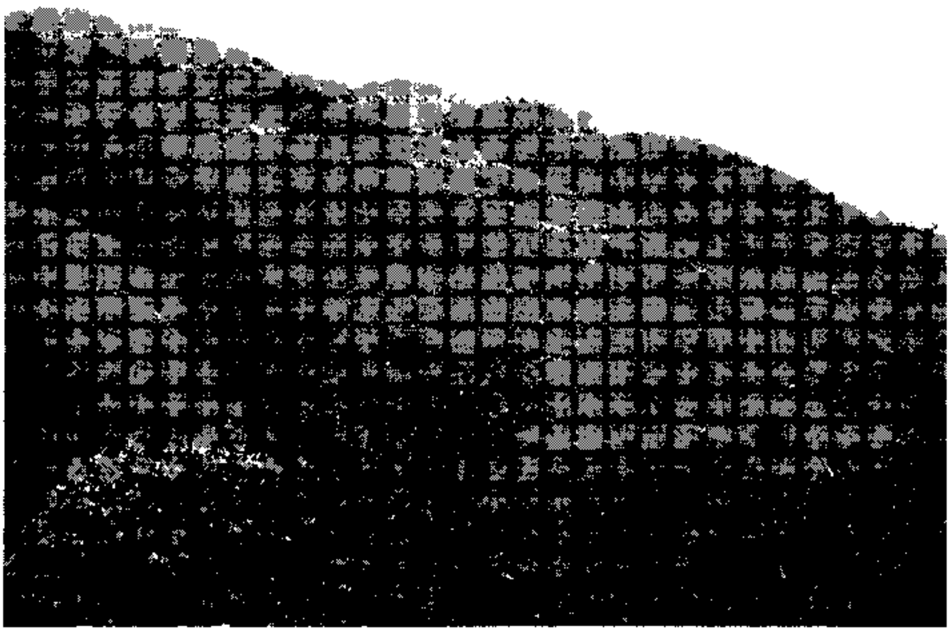


表5．平成15年度CDM植林人材育成海外ワークショップ参加者名簿

DAFTAR HADIR

Hari/tanggal : Sabtu/13 Maret 2004
Jam : 08.00 – 17.00 WIB
Tempat : Balai Sidang Bung Hatta, Novotel Bukit Tinggi
Acara : International Workshop on Developing Local Capacity for the Implementation of CDM-LULUCF Project

NO	NAMA	INSTANSI	TANDA TANGAN
1	2	3	4
1.	Zaimar, SE., Msc.	Biro Ekonomi KTR-GUB Sumbar	
2.	Drs. Bustamar, MM.	Bappeda Kab. Solok	
3.	Eka Dhamayanti, S. Hut.	BKSDA Sumbar	
4.	Dr. Rizaldi Boer	IPB	
5.	Ir. Abu Bakar B.	W. N. Paninggahan	
6.	Dr. Upik Rosalina	IPB	
7.	Rika Novida	JICA/Dephut	
8.	Rusdi Djamil	Bappeda Propinsi	
9.	Dr. Hermansah	Universitas Andalas	
10.	Ir. Sugeng Hariady	Dishut 50 kota	
11.	Zulnaidi	Bappeda Kab. 50 kota	
12.	Dr. Ir. Anang Sudarna	BPDAS Agam Kuantan	
13.	Dr. Fauzi Mas'ud	P3HKA Bogor	
14.	Dr. A. Ngaloken Gintings	P3HKA Bogor	
15.	Mitsuyoshi YATAGAI	Univ. of Tokyo	
16.	Agus Suharto	Dishut NTB	
17.	Prof. Dr. Ir. Bujang Rusman	Universitas Andalas	
18.	Nguyen Viet Khoa	Vietnam	
19.	Drs. H. Nofdinal Yefri	Dishut Kab. Pasaman Barat	
20.	Yasushi MORIKAWA	Waseda Univ. Japan	

1	2	3	4
21.	Dr. Helmi	Univ. Andalas	
22.	Ir. Hasbi Afkar	Dishut Pesisir Selatan	
23.	TAKAHASHI	JIFPRO	
24	MURATA	JIFPRO	
25.	Hisaharu HAYASHI	JIFPRO	
26.	Yoichi NAGATSUKA	JIFPRO	
27.	Nurzaman Bachtiar	Badan Litbang Daerah Sumbar	
28.	Ir. Johny Azwar	Dinas Kehutanan Propinsi Sumbr	
29.	Ir. Syawaludin	Dishutbun Pesisir Selatan	
30.	Harrison	Bappeda Kab. Pessel	
31.	Ratnawilis SPd	DPD KNPI Sumbar	
32.	Jum Anidar. SAg., MPd.	DPD KNPI Sumbar	
33.	Drs. H. Musyair Z., MS	Peneliti Lh.	
34.	Marvian M.	Bappeda Kabupaten Solok	
35.	Syamsurdi S	Pers (Padang Express)	
36	Kazuya Ando	JICA	
37.	Ibentaro S.	Humas/Umum	
38.	Ir. Bambang Wicaksono MSi.	Dishut Sawah Lunto/Sijunjung	
39.	Ir. Kasim Burhan	Disperta Bukittinggi	
40.	Syafrial Firman	Dishut Propinsi Sumbar	
41.	Ir. Tri Handoyo G.	Dinas Pertanian Kota Padang	
42.	Ir. Hendri Oktavia	Dishut Prop Sumbar	
43	Drs. H. Jufri	Wako Bkt	
44.	Ir. Sevina R.	Dishut 50 Kota	
45.	H. Kamardi Rais	Ketua LKAM Sumbar	

1	2	3	4
46.	Usman Amir	Kepala Bappeda Bkt	
47.	Yurnatik	PSLH Univ. Bung Hatta	
48.	Lani Sasmita	PSLH UBH	
49.	Afrizal Tazar	Bappeda Padang Panjang	
50.	Ir. Effia Martin	Dinas Pertanian kota Bkt	
51.	Osumi Yasuo	JIFPRO	
52.	Ir. Basri HS.	Dinas Pertanian Bukittinggi	
53.	Ir. Suarni K.	Dinas Pertanian Bukittinggi	
54.	Ir. Yanuar	Dinas Pertanian Tanah Datar	
55.	Sri Mulyani	Dinas Pertanian Tanah Datar	
56.	Ir. Irzal Sarikoen	Konsultan Lingkungan	
57.	Taswir Sy	ATIP, Padang	
58.	Dodi	Harian Mimbar Minang Padang	
59.	Muhammad Irnad	Univ. Bengkulu	
60	Dr. Elfi Sahlan Ben	Wasub Solok	
61.	Ir. Werli Hamdi	Dinas Pertanian Agam	
62.	Joni Anwar, SH.	Dishut Prop Sumbar	
63.	Ir. Yusi Rio, MSi.	Dishut SB	
64.	Yofi Yori, SE.	Dishut Prop. Sumbar	
65.	Fitri Yandra	Pemda Solok	
66.	R. R. Ariani, MSi.	Kasubbid Sarana Prasarana Bappeda Sumbar	
67.	Agus Winaryo Boyce	Conservation International	
68.	Agustien Tegawati, SH	Bappeda Pasaman	
69.	Efriyanto, SPT.	Bappeda Pasaman	
70.	Yanuar Bachrun, SH.	Dishut Sumbar	
71.	Herwandi Iman	Harian Singgalang	

1	2	3	4
72.	Ir. Darman	Hutbun Solok	
73.	Ir. Wardi Nazman, MSc.	Bappeda PYK	
74.	Ir. Budi Setiawan	PT. Inhutani IV Sumbar	
75.	Nizam Al Muluk	Dishut Kab Swl/Sjj	
76.	Definal, SP.	Pertanian Pariaman	
77.	Ir. Mawardes	Kantor Kehutanan (KKT) Padang Pariaman	
78.	Drs. Yaminu Rizal, MSi.	Bappeda Kota Pariaman	
79.	Ir. Firman Suheri, MM.	Bappeda Kab. Padang Pariaman	
80.	Anasrai	RRI Bukittinggi	
81.	Zarratul Khairi, SE, MT.	Bappeda Kab. Tanah Datar	
82.	Dasrul	Bag. LH. Kab. Tanah Datar	
83.	Y. A. Nganfat	PKSSB	
84.	Zuwendra	Dishut Prop. Sumbar	
85.	Adrianto, SH.	Dishut Sumbar	
86.	Alimin Djisbar	Main Cooperation for Improvement of Technology and Agroforestry Community Welfare	

Pimpinan Rapat,

ZUWENDRA

資料５．海外研修ワークショップの総括取りまとめ（和訳）

２００４年3月１３日に、ブキティンギ市 Bung Hatta 会館で開催されたワークショップにおけるブキティンギ市長、JIFPRO 林　専務、西スマトラ州知事のあいさつ、及び９つの発表、並びに討論を踏まえ、ワークショップの結論として以下のとおり取りまとめる。

１．西スマトラ州、およびソロ地区行政府は CDM 植林プロジェクトを全面的に支持する。

２．部族領地(clan land)は、村落共同体の所有地で、Penghulu（村長）/　Ninik Mamak（儀礼の指導者）の調整の下、CDM 植林プロジェクトに使用可能である。しかし、その計画、実施、モニタリング、評価の各段階で地域住民の参画が必要である。

３．この地域には 137,490ha の荒廃地があり、この復旧のために、一部 CDM 植林としての予算が必要となろう。

４．要復旧地域に関する資料はあるが、CDM 植林が可能な地域は更に選別する必要があり、CDM 植林を実施するための第一歩として CDM 可能地域の図化が特に重要である。

５．CDM 植林の実施には時間がかかるため、西スマトラからの参加者は、
①小規模な友好の森を早期に実施すること、②実際のモデル事業の実行を通じて人材育成を促進すること、という２点を提案した。

６．林木による炭素固定能力は、標本木の伐採、バイオマスと胸高直径の関係式の作成により測定可能である。

７．森林被害がなければ大気中の炭素は安定であるが、森林伐採が各地で既に進行している以上、対策が必要である。CDM 植林はその一つの選択肢である。

８．バイオマスの測定は、JIFPRO と FORDA の協力、ボゴール農科大学、JICA、ムラワルマン大学、ICRAF, UNIBRAW 等によってマンギウム、メルクシ マツ、ファルカータ、マホガニーなどについて行われている。

９．CDM 植林の実施には PDD の作成が重要であり、そのための利害関係者の能力開発が必要である。

１０.部族領地(clan land)のうち傾斜度３７％以下の地域が有望な CDM 植林対象地である。

資料6．2004年3月15日付 Mimbar Minang 紙 関係記事（インドネシア語）の英訳

Translated from Mimbar Minang Newspaper (Local Indonesian Newspaper released especially for Bukitinggi, West Sumatra Province), issued on Monday, 15 March 2004:

Mitigation of Global Warming:

West Sumatra Province: The Most Readily Prepared in Implementing the CDM Attempts

West Sumatra appears to be a province in Indonesia the most readily prepared in implementing the clean development mechanisms (CDM) for the mitigation of greenhouse gases (GHG) effects, which has posed a serious threat to the global warming.

Such statement was raised in the recommendation at the International Workshop on "Developing Local Capacity for the Implementation of CDM – LULUCF Projects" held on 13 March 2004, Bukitinggi (West Sumatera – Indonesia).

In the final formulation of the International Workshop as read by the OC's local Committee, Mr. Zuwendra Bulek B.S. revealed that the thorough preparation of the West Sumatra Province in implementing the CDM was discussed and figured out by scientific experts from Japan, Vietnam, and 80 stakeholders participated in the Workshop which was held through the cooperation involving Japan International Forestry Promotion & Cooperation Center (JIFPRO), Bogor Agricultural University (under the Indonesian Ministry of Education and Culture), and Agency for Forestry Research and Development (under the Indonesian Ministry of Forestry). The international Workshop even wrapped up to the conclusion that the Singkarak area especially Nagari Paninggahan site has been prepared to implement the pre-CDM attempt.

Meanwhile, Head of Forestry Services of West Sumatra, Mr. Johny Azwar B.S. who also participated in the International Workshop warned and reminded that the huge accumulation of GHG concentration had seriously impaired the global climate system. Further, it is approximated that the current rate of global warming will bring about the increase in global temperature by 0.5°C within only every 10-year period. His statement was based on Risser's.

CDM present a mechanism to mitigate GHG emission and concurrently develop what is called a "certified emission reduction" (CER) that should be intensively implemented. The most principal is that trees which are planted and then grown in complying with the CDM project will be counted how much they can absorb or sequester carbon per hectare per year (i.e. carbon take-up from the atmosphere). "Such counting results will be assessed and further purchased by the investors from developed countries (carbon trading) thereby deserving the acquirement of CDM's certificate" as stated by the Head of West Sumatra's Forestry Services.

West Sumatra indeed owns a lot of potential areas for the CDM implementation, among others: rain-catching areas at the upstream and surrounding of Singkarak Lake; in the vicinity, higher regions, and lower regions of Singkarak Lake; rain-catching area at the upstream and surrounding of Maninnjau Lake; and watershed area of the Batanghari River

In another occasion during the Workshop, Dr. Rizaldi Boer from the Climatic Laboratory of the Bogor Agricultural University expressed his view that the availability of area for carbon sequestration is quite vast, i.e. 40 million hectares in 2000. However, referring to the Kyoto Protocol, he further stated that reforestation activities can work out well as the CDM project if the areas that will be used are the ones before 31 December 1989 existing no longer as forest.

Likewise, he also added that the appropriate area for afforestation activities is substantially decreasing as well. It is approximated that there are only 8 million hectares that still remain following the abandonment since 1990 as shrubs and grasslands inside the forest area. However, he further declared that if the Canada proposal were accepted for the time-limit alteration from 1990 – 2000, the potential forest area for the CDM implementation would reach 18 million hectares. This one-day International Workshop also presented several prominent local as well as overseas forestry experts, such as Prof. Morikawa (Waseda University, Japan), Dr. A. Ngaloken Gintings (Senior Research Scientist at Forest and Nature Conservation R & D Center, Bogor – Indonesia), Dr. Alimin Djisbar (Senior Research Scientist at R & D Center for Industrial Crop Plants), Dr. A. Fauzi Mas'ud (JICA Representative and Director of Forest and Nature Conservation R & D Center, Bogor – Indonesia), Mr. H. Gamawan Fauzi (Head of Solok Sub District), and KHR Dt. P. Simulie (Head of LKAAM, West Sumatra – Indonesia)

資料7．2004年3月15日付け Singgalang紙 関係記事（インドネシア語）の英訳

Translated from Singgalang Newspaper (Local Indonesian Newspaper released especially for Bukittinggi, West Sumatra Province), issued on Monday, 15 March 2004:

In the Reformation Era:
Forest Destruction Turns-out to be Indeed Higher

Forest destruction indeed sustained more severe destruction in the reformation era. At the national level, forest destruction in Indonesia currently has proceeded at 1.8 – 2.0 million hectares per year or more than 4,000 hectares per day. In comparison with the situation in the preceding decades, the forest destruction then reached only 1.6 million hectares per year.

In a West Sumatra province with current forest area of 2,600,286 hectares, there have been some substantial decreases in forest areas during the last two decades due to forest logging and forest products extraction. Such decreases also included forest area reserved for protection and even for conservation/tourisms. Such was raised by the Regional Governor for West Sumatera Province, Mr. H. Zainal in the International Workshop on "Developing Local Capacity for the Implementation of CDM – LULUCF Projects" held on 13 March 2004, Bukitinggi (West Sumatera – Indonesia).

Such written Governor's welcome was read by Head of the West Sumatera's Forestry Research and Development Agency, Prof. Dr. Nurzaman Bachtiar, MSc which further stated that the technical loss and destruction of forest in West Sumatera afflicted fatal results in consequence with the topography, physiography, and geography condition of West Sumatera situated in tropical region. Such condition renders West Sumatera region more vulnerable to erosion and land-slide disaster. Likewise, it also induces the impairment of hydrology system, the increasing rate of land-fertility degradation, and the imbalance of ecosystem at the river bank as well as coast line.

Moreover, West Sumatera region according the Regional Governor seems more labile in terms of geology views. The soil there is dominated by the less fertile type, thereby the recovery of the degraded land progressing slowly and recurring back to the former situation difficult or almost impossible.

The Governor further stated that forest destruction in West Sumatera categorized as critical land currently has reached 175,914 hectares of which 29,688 hectares is inside the forest while 145,914 hectares outside. In consequence, during the years 2002 – 2003 there occurred flood disasters 28 times, land slide 44 times, and erosion 3 times with the accompanying substantial financial loss as well as living loss.

The International Workshop as held at the Novotel Hotel, Bukitinggi (West Sumatera) proceeded under the cooperation involving Regional Authority of Bukitinggi, Bogor Agricultural University, Forestry Research and Development Agency (FORDA), and Japan International Forestry and Cooperation Center (JIFPRO). Such national-level Workshop was attended by 85 participants from Japan, Thailand, Philippines, Head and Representatives of Regional Authorities, and Heads of consecutively Forestry and Agricultural Services of West Sumatera. The Workshop, besides being attended by the JIFPRO and FORDA Officials, also invited the Town Mayor of Bukittinggi, Mr. H. Djufry who delivered a welcoming speech.

In that occasion during the Workshop, Head of West Sumatera's Forestry Services, Ir. Johny Azwar expressed that activities of the critical lands actually has begun since 1970. Unfortunately, the level of success is not yet optimum. Recently, the national attempt to rehabilitate forest and vegetation area has been implemented by providing as many as 24.9 millions of young trees with the expected target achieving 29,401 hectare area in 2003.

Another alternative that is currently implemented is the enhancement of CDM. According to Mr. Johny Azwar, CDM presents a mechanism to mitigate the greenhouse gas (GHG) emission which is afforded by developed countries to acquire what is so called "certified emission reduction" (CER).

He further added that the types of CDM activities are principally similar to those of reforestation and afforestation. However, the CDM implementation proceeds intensively beginning from the planning, socialization, development, institution, maintenance, until the securing of results.

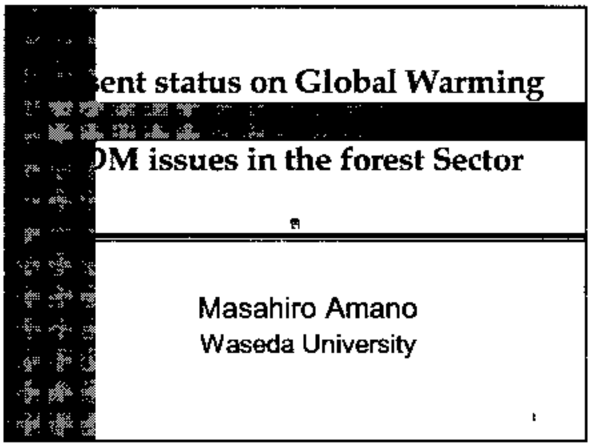
The most principal in his opinion is that each of the trees planted and grown will be counted of the carbon amount that can be sequestered per hectare per year, and further be purchased by investors from the developed countries.

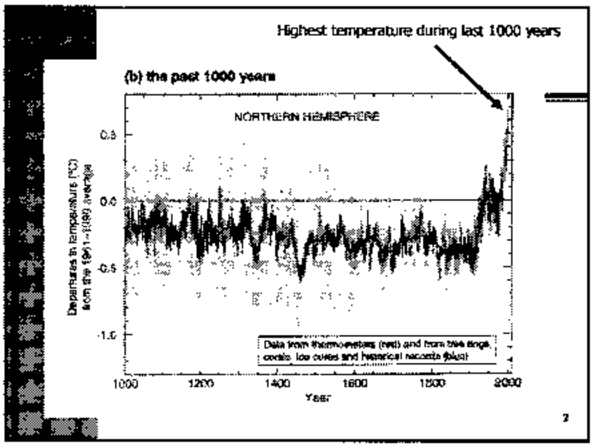
Several locations that may be appropriately feasible for the CDM implementation, according to Mr. Johny Azwar, are among others: rain-catching area at the upstream and the surrounding of Singkarak Lake, flat plain in Solok District, the vicinity at the higher and lower area near the Lake, rain-catching area at the upstream Electric Generation Dam (Koto Panjang), 50 towns surrounding Maninjau Lake, watershed region of the Batanghari river, South Solok, and Sawahlunto Sijunjung.

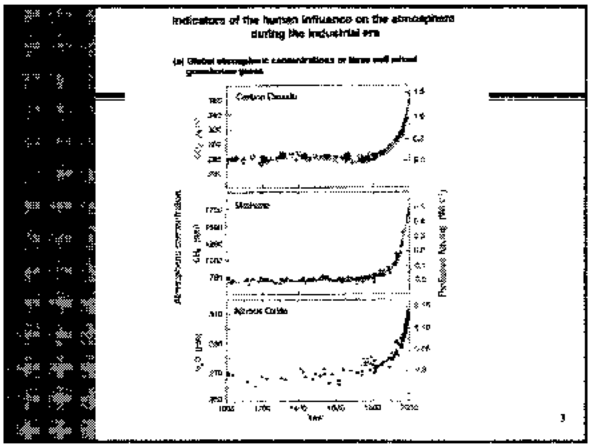
Among the presenters that delivered their scientific idea/paper were Dr. Alimin Djisbar as the Responsible Chief of Master Cooperation for the Enhancement of Technology and Agriculture/Forestry Community Welfare; Dr. A. Nagloken Gintings as Senior Research Scientist at Forest and Nature Conservation R & D Center, Bogor – Indonesia; Prof. Yayuishi Morikawa as the JIFPRO Official; Mr. H. Gamawan Fauzi (Head of Solok Sub District), and KHR Dt. P. Simulie (Head of LKAAM, West Sumatera – Indonesia)

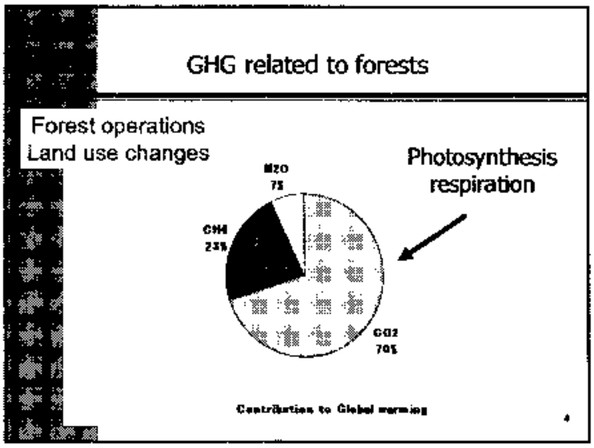
資料１．国内研修の教材（概要版）

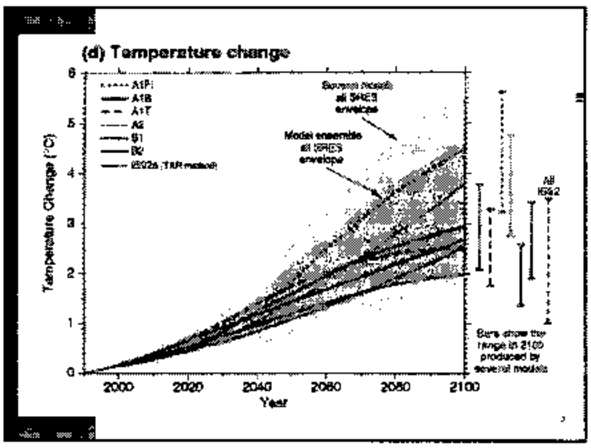
（研修用教材は各担当講師により英文で作成された。）

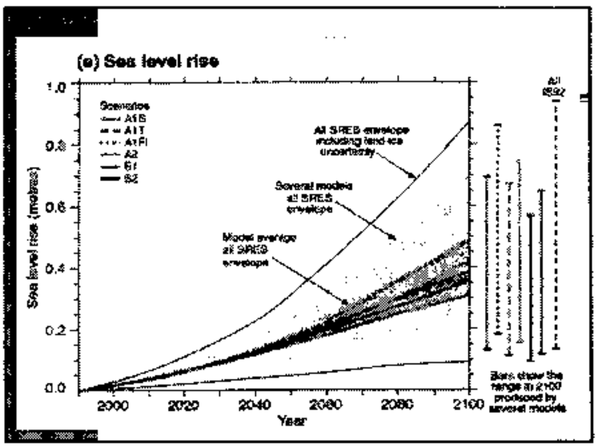

ent status on Global Warming
M issues in the forest Sector
Masahiro Amano
Waseda University
1

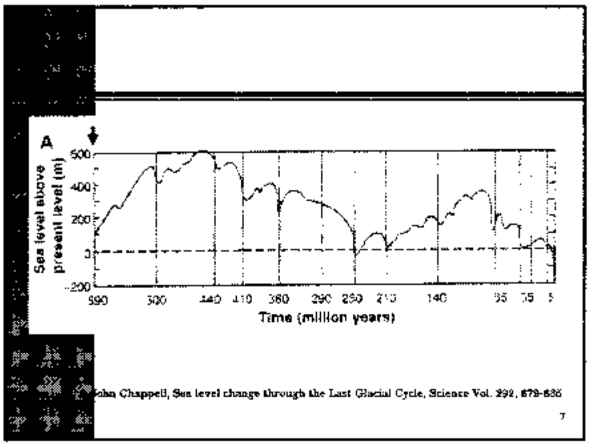

Highest temperature during last 1000 years
(b) the past 1000 years
NORTHERN HEMISPHERE
Departures in temperature (°C) from the 1961-1990 average
Data from thermometers (red) and from tree rings, corals, ice cores and historical records (blue)
Year
2

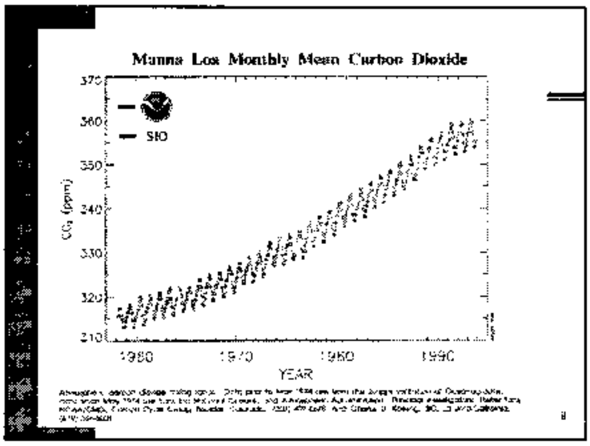

Indicators of the human influence on the atmosphere during the industrial era
Carbon Dioxide
Methane
Nitrous Oxide
Atmospheric concentration
Radiative forcing
3

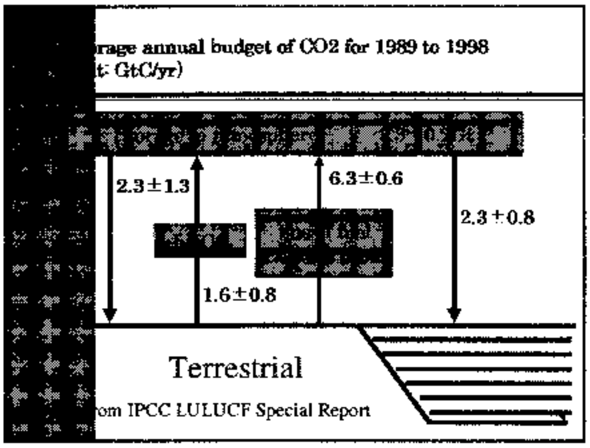

GHG related to forests
Forest operations
Land use changes
Photosynthesis
respiration
N2O
7%
CH4
23%
CO2
70%
Contribution to Global warming
4

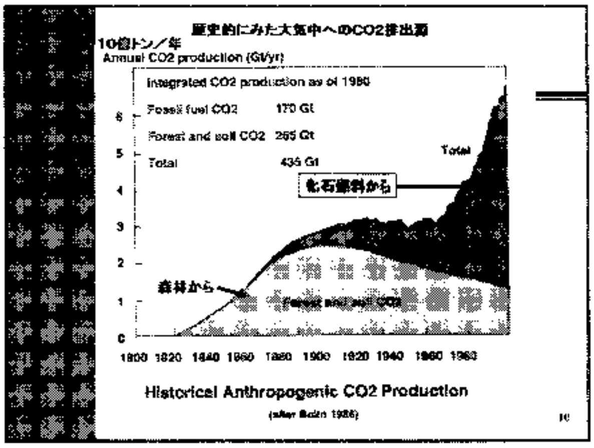

(d) Temperature change
A1FI
A1B
A1T
A2
B1
B2
IS92a (TAR method)
Several models all SRES envelope
Model ensemble all SRES envelope
All IS92
Bars show the range in 2100 produced by several models
Temperature Change (°C)
Year

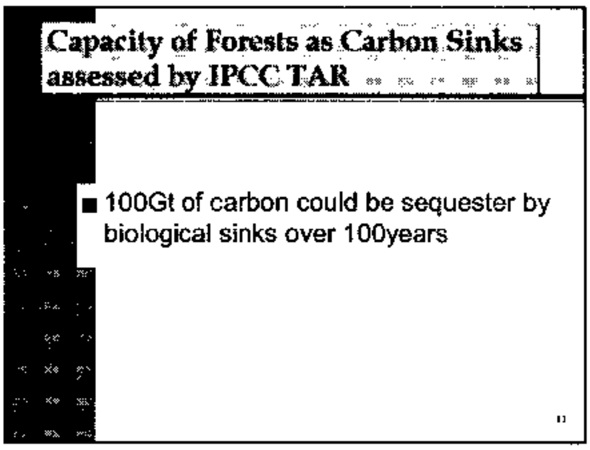

(e) Sea level rise
Scenarios
A1B
A1T
A1FI
A2
B1
B2
All SRES envelope including land-ice uncertainty
Several models all SRES envelope
Model average all SRES envelope
All IS92
Bars show the range in 2100 produced by several models
Sea level rise (metres)
Year

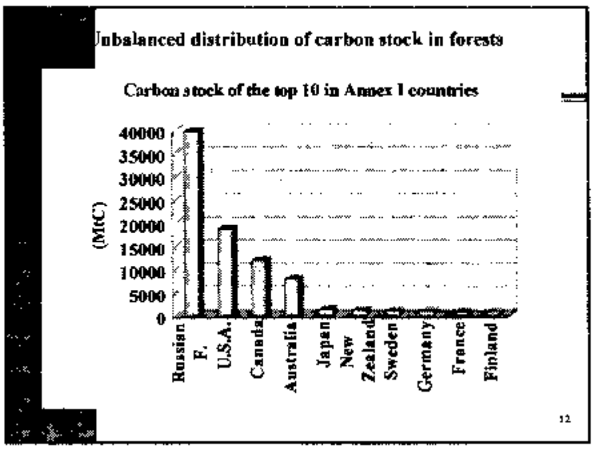

A
Sea level above present level (m)
500
400
200
0
-200
590
500
440
410
360
290
250
210
140
65
35
5
Time (million years)
ohn Chappell, Sea level change through the Last Glacial Cycle, Science Vol. 292, 679-686
7

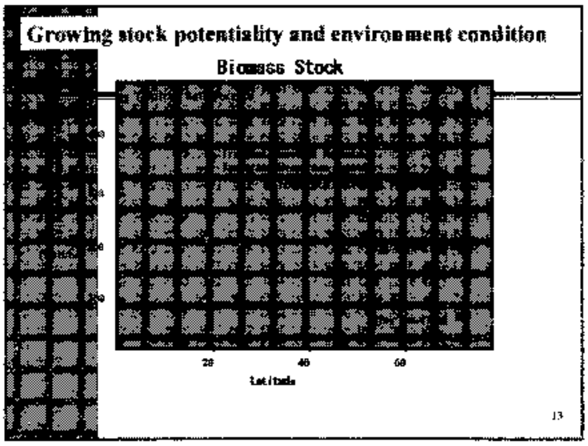

Mauna Loa Monthly Mean Carbon Dioxide
SIO
370
360
350
340
330
320
310
1960
1970
1980
1990
YEAR
8

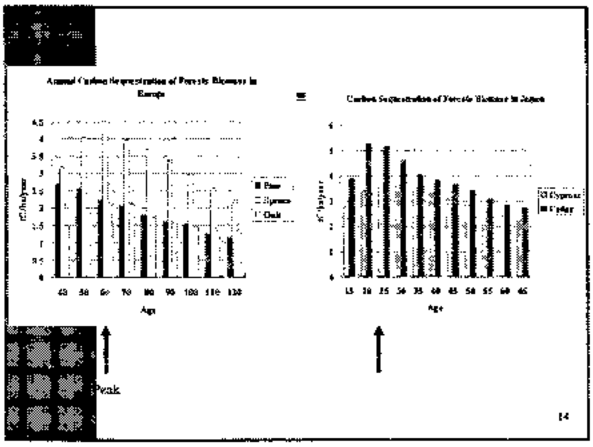

rage annual budget of CO2 for 1989 to 1998
t: GtC/yr)
2.3±1.3
6.3±0.6
2.3±0.8
1.6±0.8
Terrestrial
om IPCC LULUCF Special Report

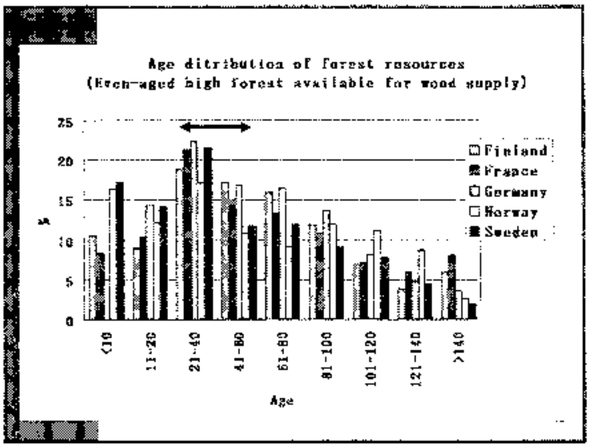

歴史的にみた大気中へのCO2排出量
10億トン/年
Annual CO2 production (Gt/yr)
Integrated CO2 production as of 1980
Fossil fuel CO2 170 Gt
Forest and soil CO2 265 Gt
Total 435 Gt
Total
化石燃料から
森林から
Forest and soil CO2
1800 1820 1840 1860 1880 1900 1920 1940 1960 1980
Historical Anthropogenic CO2 Production
10

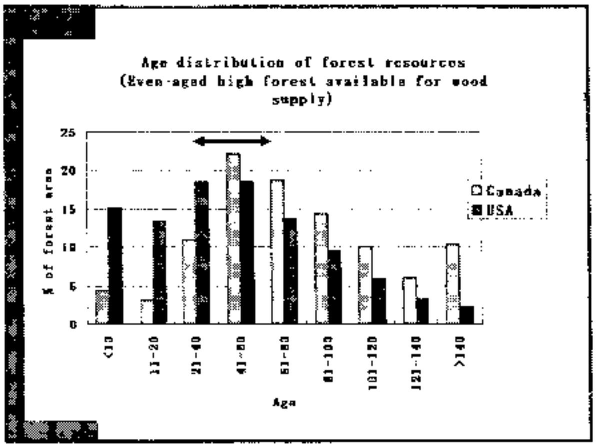

Capacity of Forests as Carbon Sinks
assessed by IPCC TAR
■ 100Gt of carbon could be sequester by
biological sinks over 100years
11

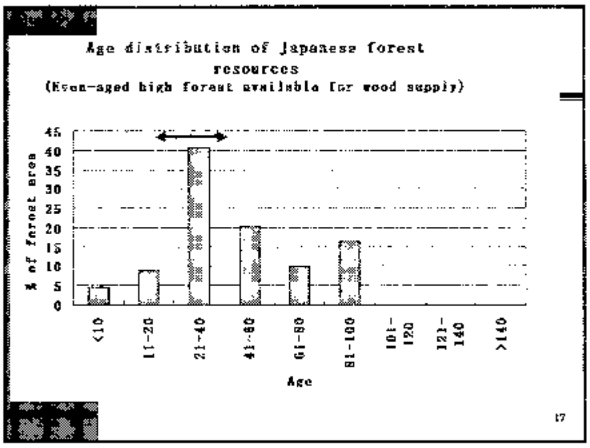

Unbalanced distribution of carbon stock in forests
Carbon stock of the top 10 in Annex I countries
(MtC)
40000
35000
30000
25000
20000
15000
10000
5000
0
Russian F.
U.S.A.
Canada
Australia
Japan
New Zealand
Sweden
Germany
France
Finland
12

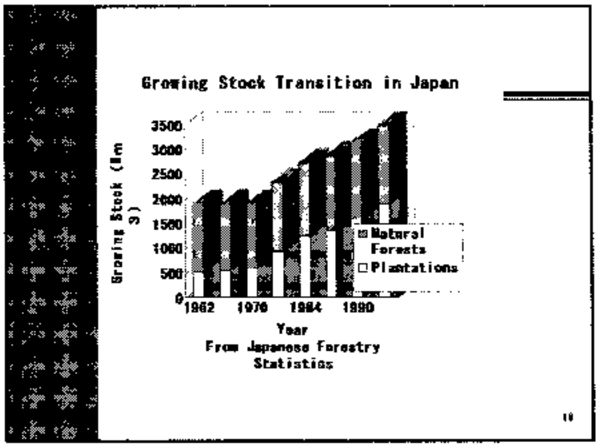

Growing stock potentiality and environment condition
Biomass Stock
20
40
60
Latitude
13

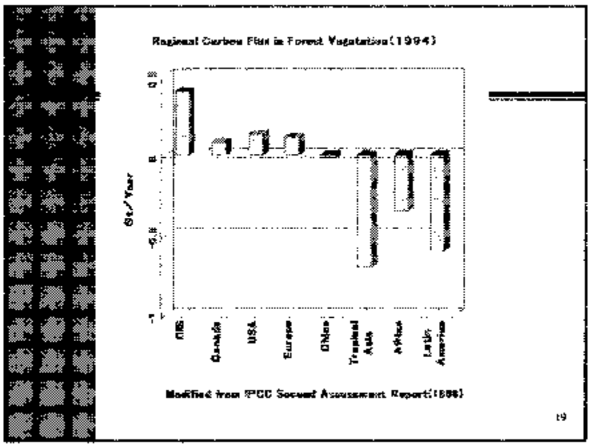

Age
Age
14

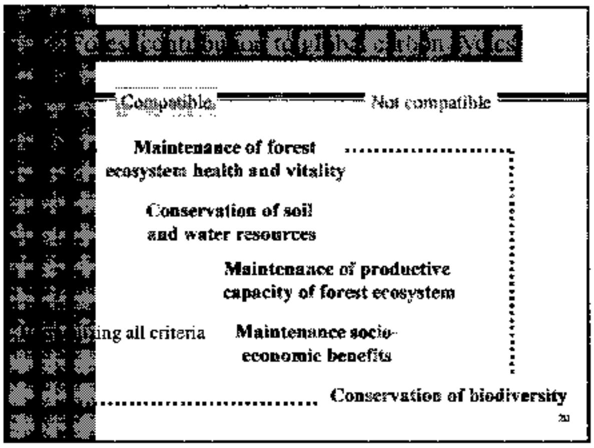

Age ditribution of forest resources
(Even-aged high forest available for wood supply)
Finland
France
Germany
Norway
Sweden
%
<10
11-20
21-40
41-60
61-80
81-100
101-120
121-140
>140
Age

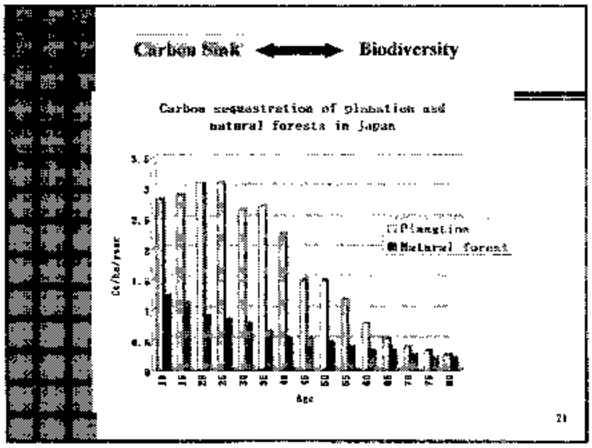

Age distribution of forest resources
(Even-aged high forest available for wood supply)
Canada
USA
% of forest area
<10
11-20
21-40
41-60
61-80
81-100
101-120
121-140
>140
Age

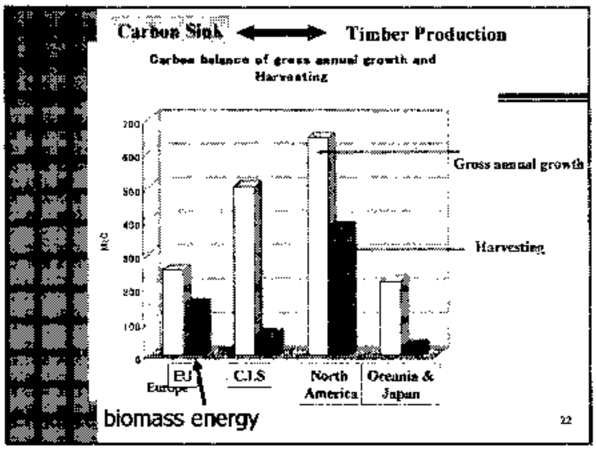

Age distribution of Japanese forest resources
(Even-aged high forest available for wood supply)
% of forest area
<10
11-20
21-40
41-60
61-80
81-100
101-120
121-140
>140
Age
17

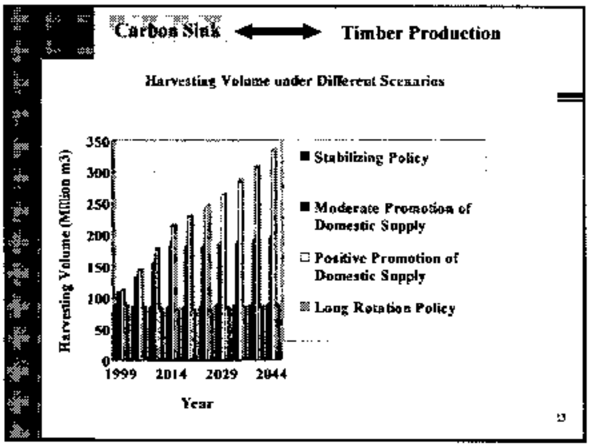

Growing Stock Transition in Japan
Growing Stock (Mm3)
Natural Forests
Plantations
1962
1970
1984
1990
Year
From Japanese Forestry Statistics

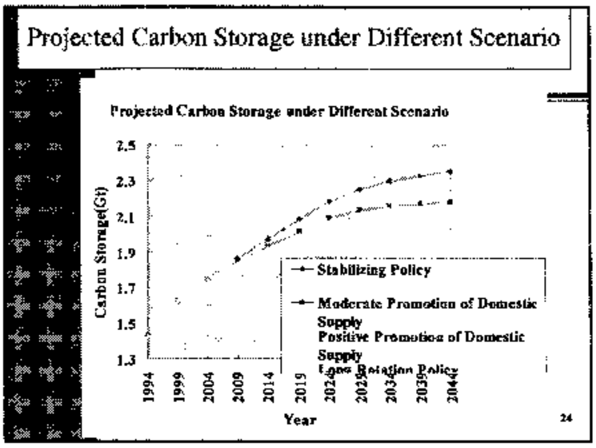

Regional Carbon Flux in Forest Vegetation (1994)
Gt/Year
CIS
Canada
USA
Europe
Others
Tropical Asia
Africa
Latin America
Modified from IPCC Second Assessment Report(1996)
19


Compatible
Not compatible
Maintenance of forest ecosystem health and vitality
Conservation of soil and water resources
Maintenance of productive capacity of forest ecosystem
Maintenance socio-economic benefits
Conservation of biodiversity
20


Carbon Sink
Biodiversity
Carbon sequestration of plantation and natural forests in Japan
Plantation
Natural forest
Age
21


Carbon Sink
Timber Production
Carbon balance of gross annual growth and Harvesting
Gross annual growth
Harvesting
EU
C.I.S
North America
Oceania & Japan
Europe
biomass energy
22


Carbon Sink
Timber Production
Harvesting Volume under Different Scenarios
Harvesting Volume (Million m3)
Stabilizing Policy
Moderate Promotion of Domestic Supply
Positive Promotion of Domestic Supply
Long Rotation Policy
1999
2014
2029
2044
Year


Projected Carbon Storage under Different Scenario
Projected Carbon Storage under Different Scenario
Carbon Storage(Gt)
Stabilizing Policy
Moderate Promotion of Domestic Supply
Positive Promotion of Domestic Supply
Long Rotation Policy
Year
24

Carbon Sink ⟷ **Timber Production**

Long term perspective

expansion of forest plantations for carbon credit

↓

Reduction of price for industrial round wood by oversupply

25

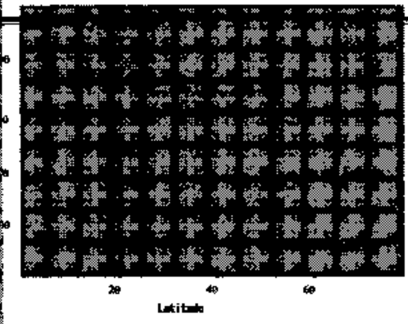
Carbon sinks for developing countries

- High growth rate and high potentiality
- Stimulate to protect forest degradation and deforestation
- Insufficient Inventory System
- Negative direction of land use changes for expanding farming land

26

High growth rate and high potentiality

Biomass Stock



27

...ate to protect forest degradation and deforestation

TROPICAL FORESTS IN THE CARBON CYCLE 67

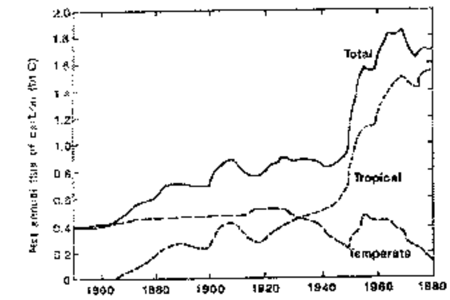
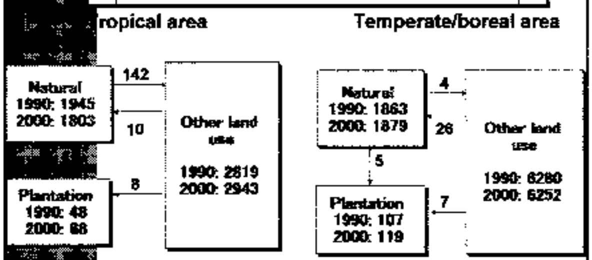


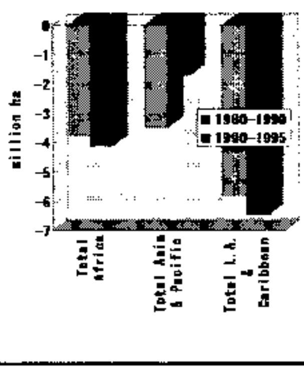
Figure 3.1 Net annual flux of carbon from deforestation in tropical and temperate zones, 1850 to 1980. Based on Houghton and Skole (1990), following Woodwell (1992)

28

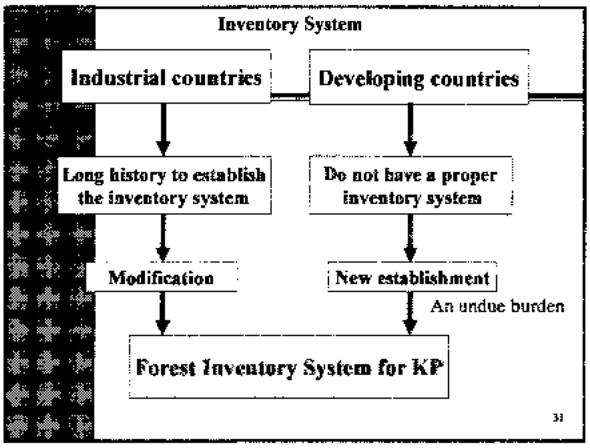
Forest land changes
(Unit : Mh a)

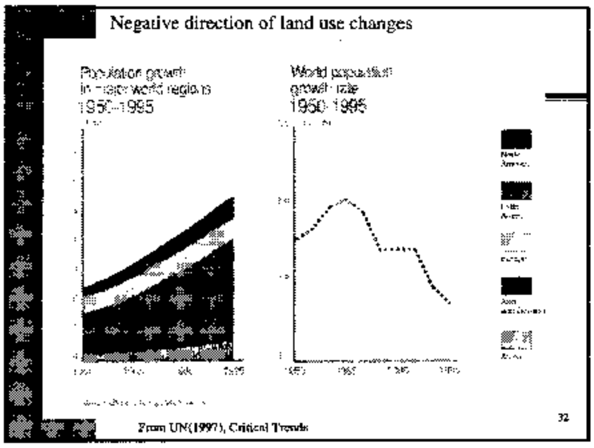


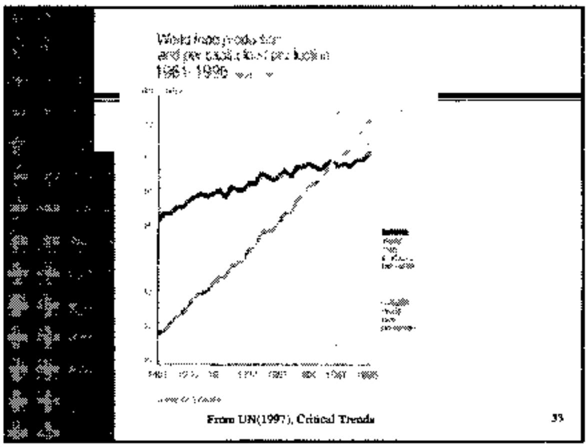
29

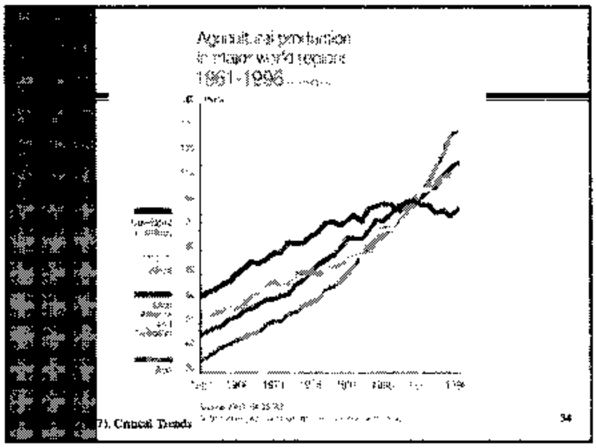


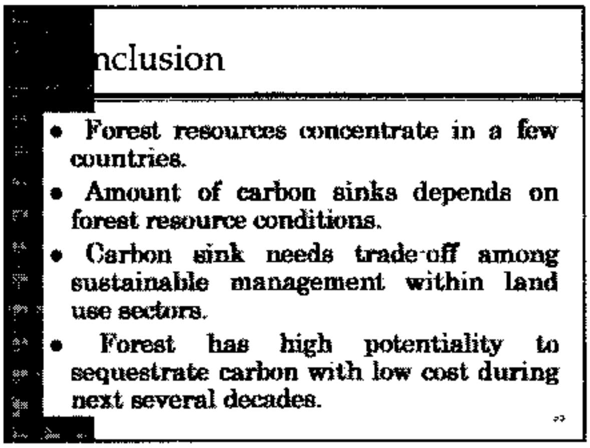
30

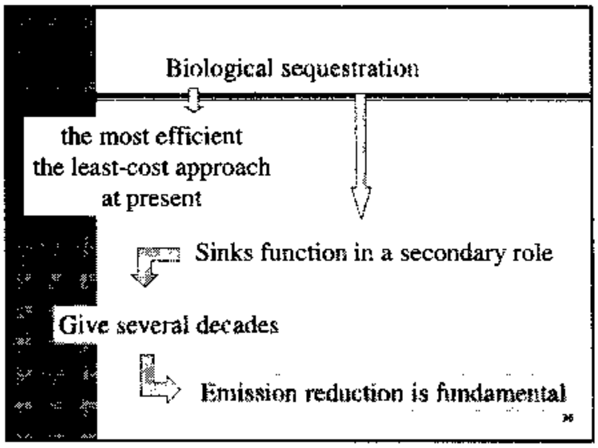

Inventory System
Industrial countries
Developing countries
Long history to establish the inventory system
Do not have a proper inventory system
Modification
New establishment
An undue burden
Forest Inventory System for KP
31

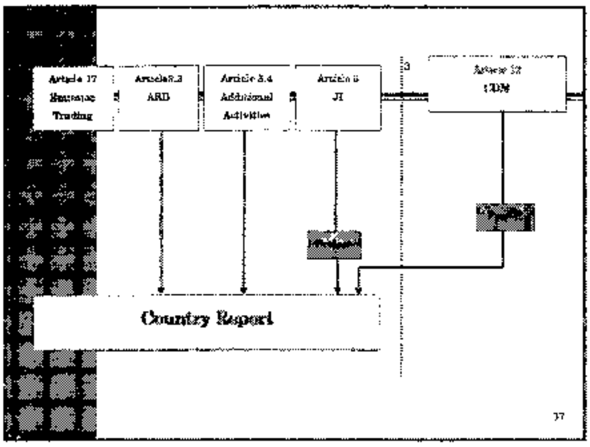

Negative direction of land use changes
From UN(1997), Critical Trends
32

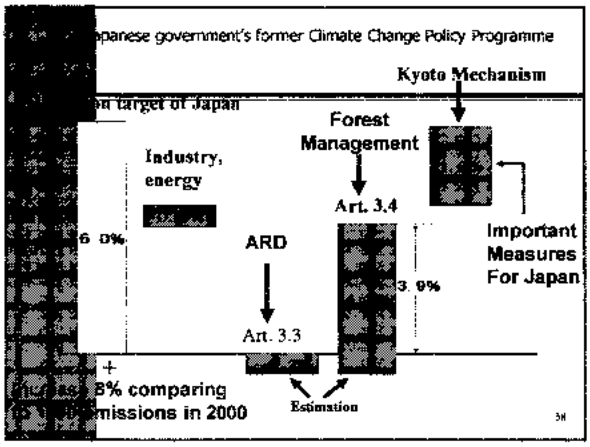

From UN(1997), Critical Trends
33

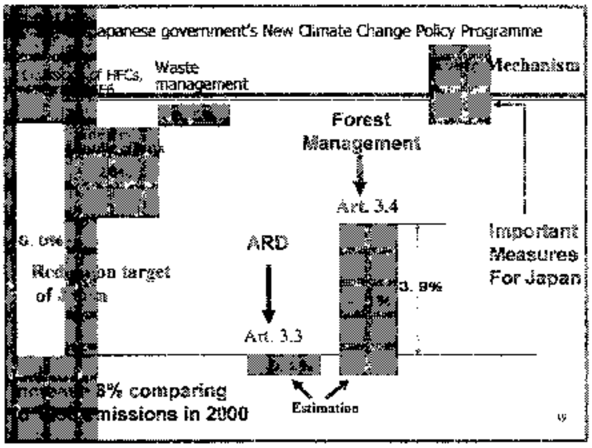

7), Critical Trends
34

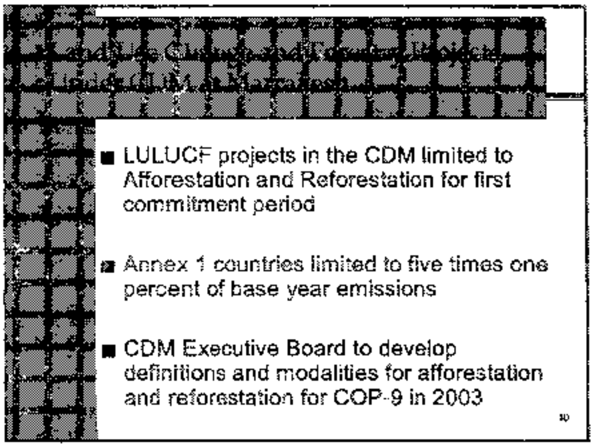

nclusion
• Forest resources concentrate in a few countries.
• Amount of carbon sinks depends on forest resource conditions.
• Carbon sink needs trade-off among sustainable management within land use sectors.
• Forest has high potentiality to sequestrate carbon with low cost during next several decades.

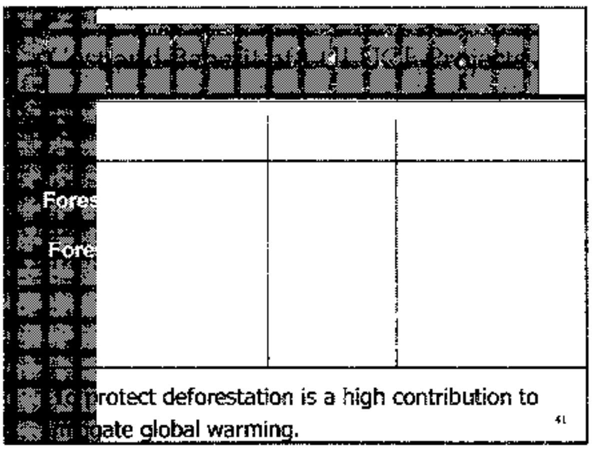

Biological sequestration
the most efficient
the least-cost approach
at present
Sinks function in a secondary role
Give several decades
Emission reduction is fundamental

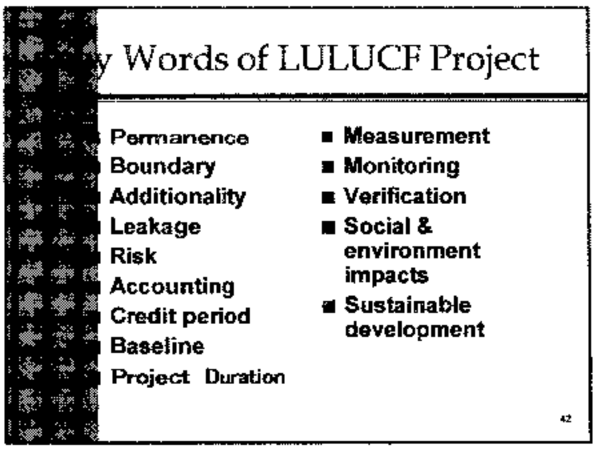

ARD
JI
Country Report

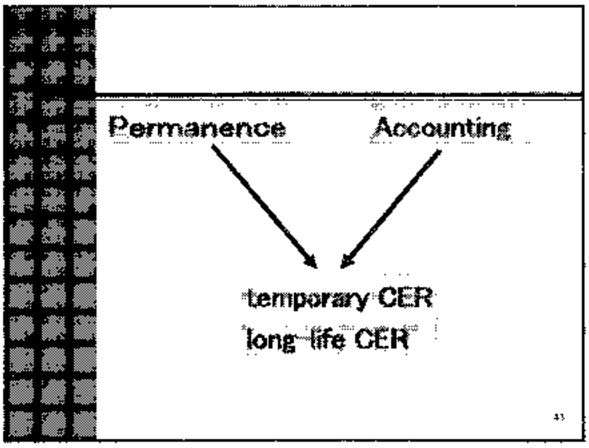

panese government's former Climate Change Policy Programme
Kyoto Mechanism
Forest Management
Industry, energy
Art. 3.4
ARD
Important Measures For Japan
3.9%
Art. 3.3
3% comparing
missions in 2000
Estimation

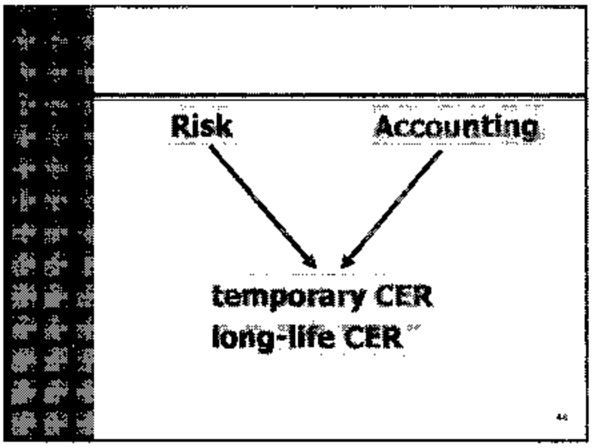

apanese government's New Climate Change Policy Programme
Waste management
Forest Management
Art. 3.4
ARD
Important Measures For Japan
3.9%
Art. 3.3
3% comparing
missions in 2000
Estimation

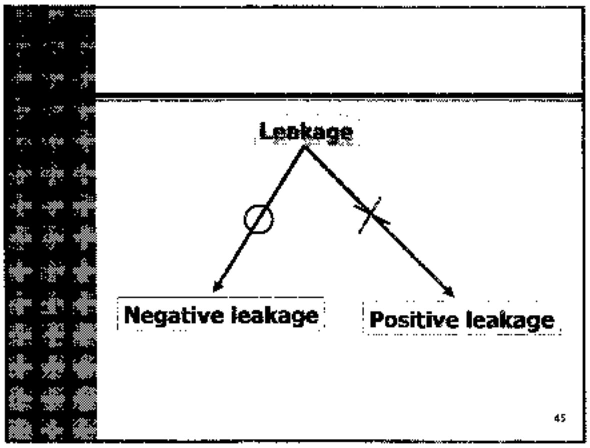

LULUCF projects in the CDM limited to Afforestation and Reforestation for first commitment period
Annex 1 countries limited to five times one percent of base year emissions
CDM Executive Board to develop definitions and modalities for afforestation and reforestation for COP-9 in 2003

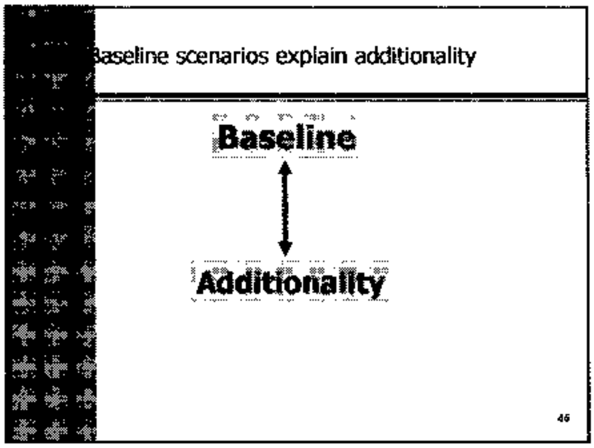

protect deforestation is a high contribution to
gate global warming.

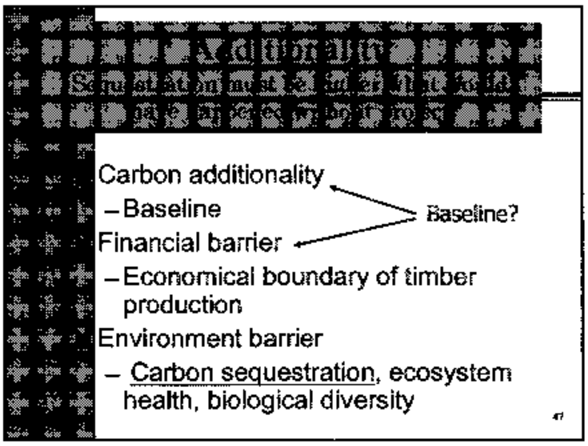

Words of LULUCF Project
Permanence
Boundary
Additionality
Leakage
Risk
Accounting
Credit period
Baseline
Project Duration
Measurement
Monitoring
Verification
Social & environment impacts
Sustainable development

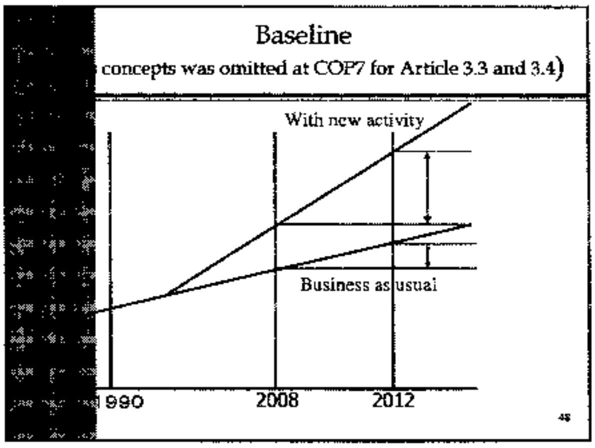

Permanence
Accounting
temporary CER
long-life CER

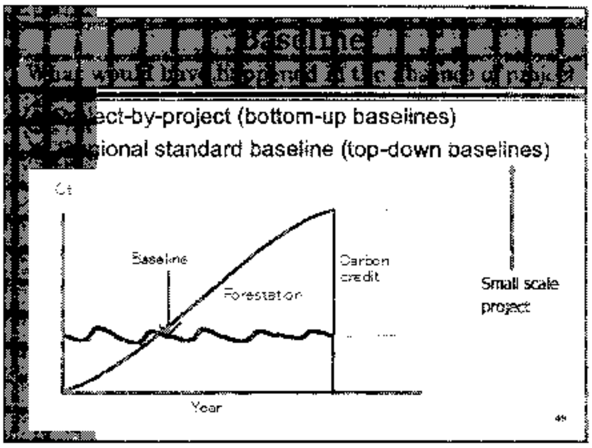

Risk
Accounting
temporary CER
long-life CER

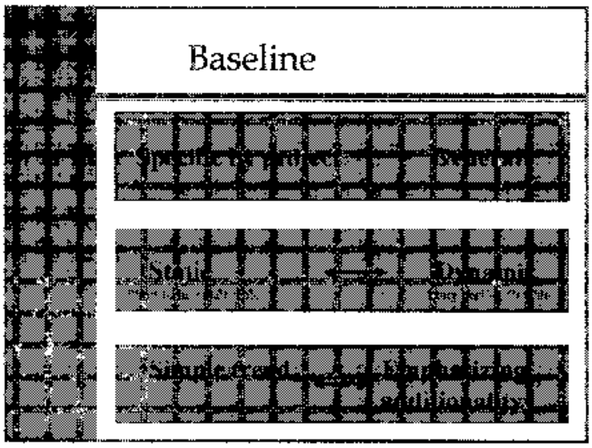

Leakage
Negative leakage
Positive leakage

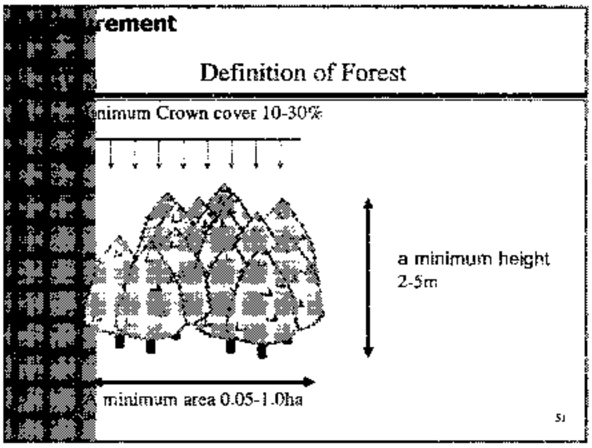

aseline scenarios explain additionality
Baseline
Additionality

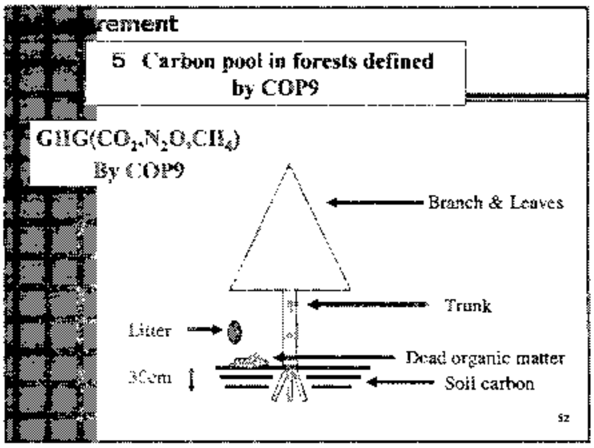

Carbon additionality
– Baseline
Baseline?
Financial barrier
– Economical boundary of timber production
Environment barrier
– Carbon sequestration, ecosystem health, biological diversity

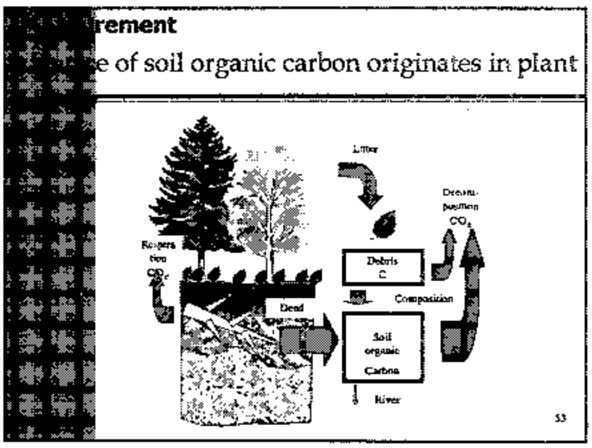

Baseline
concepts was omitted at COP7 for Article 3.3 and 3.4)
With new activity
Business as usual
990
2008
2012

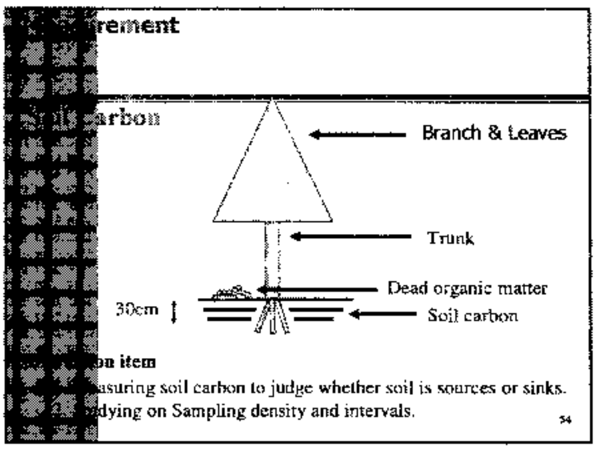

Baseline
ect-by-project (bottom-up baselines)
ional standard baseline (top-down baselines)
Ct
Baseline
Carbon credit
Forestation
Small scale project
Year

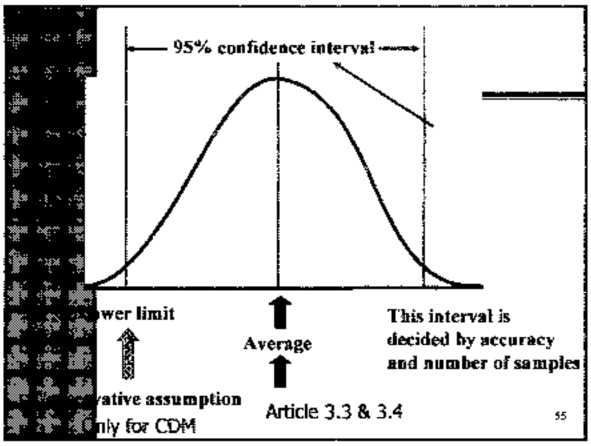

Baseline

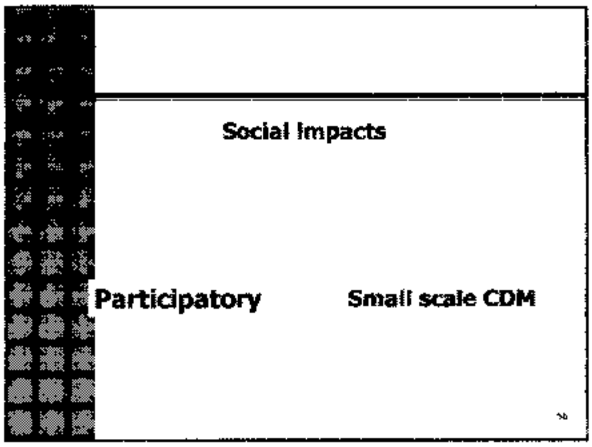

rement
Definition of Forest
nimum Crown cover 10-30%
a minimum height 2-5m
minimum area 0.05-1.0ha
51

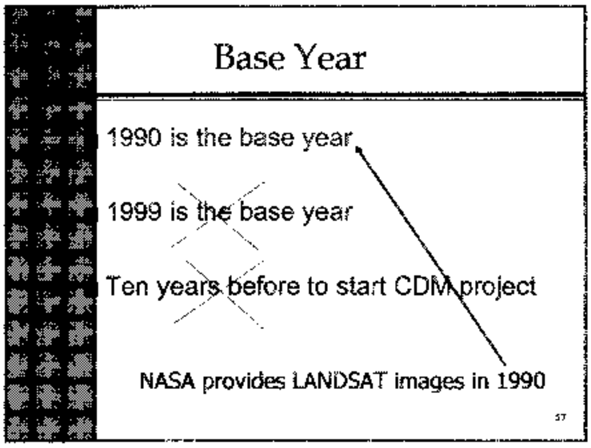

rement
5 Carbon pool in forests defined by COP9
GHG(CO2,N2O,CH4)
By COP9
Branch & Leaves
Trunk
Litter
Dead organic matter
30cm
Soil carbon
52

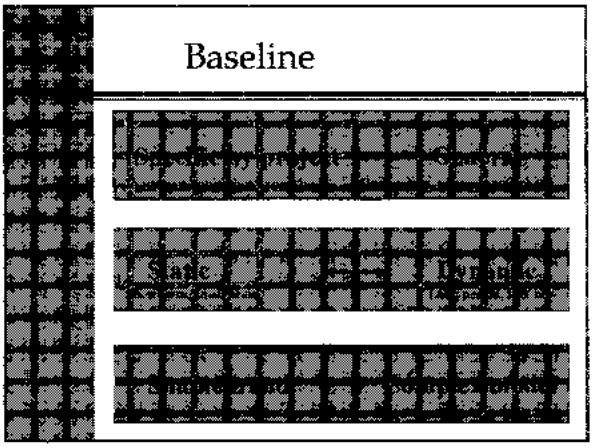

rement
e of soil organic carbon originates in plant
Litter
Respiration CO2
Debris C
Composition
Dead
Soil organic Carbon
River
53

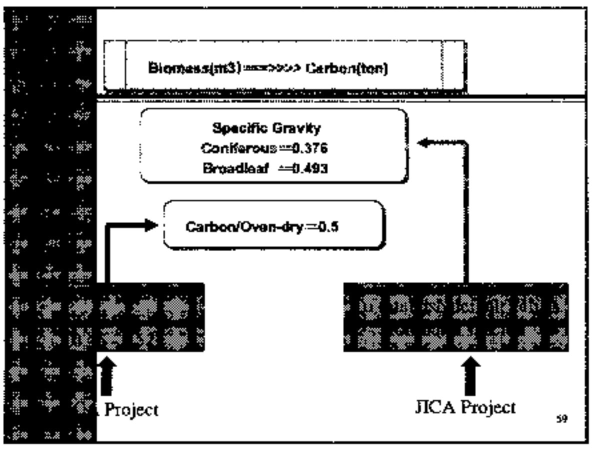

rement
arbon
Branch & Leaves
Trunk
Dead organic matter
30cm
Soil carbon
n item
asuring soil carbon to judge whether soil is sources or sinks.
dying on Sampling density and intervals.
54

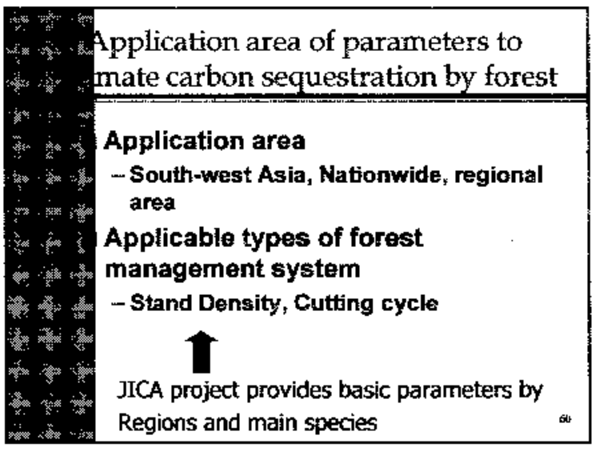

95% confidence interval
wer limit
Average
This interval is
decided by accuracy
and number of samples
ative assumption
nly for CDM
Article 3.3 & 3.4
55


Social Impacts
Participatory
Small scale CDM


Base Year
1990 is the base year
1999 is the base year
Ten years before to start CDM project
NASA provides LANDSAT images in 1990
57


Baseline


Biomass(m3)=====>>>> Carbon(ton)
Specific Gravity
Coniferous==0.376
Broadleaf ==0.493
Carbon/Oven-dry==0.5
Project
JICA Project
59


Application area of parameters to
mate carbon sequestration by forest
Application area
– South-west Asia, Nationwide, regional area
Applicable types of forest management system
– Stand Density, Cutting cycle
JICA project provides basic parameters by
Regions and main species

asurement and Monitoring

- Monitoring can be by project participant or a third party
- Projects are requested a higher accurate report rather than national inventory level
  - Project boundary, carbon pool
  - Socio-economic data

61

parency and Verification ⟵ JICA Project

- Database for open access
- Data process for evaluating Carbon
- Publication
- Maintenance of study plots

62

Monitoring Biomass

- Index or proxy for monitoring
- Potentiality of using remote sensing

↓

↑

Verification data through ground-truth

Include projection and leakage

63

nable development and LULUCF projects

- International criteria for sustainable development (X)
- Criteria developed by host country for sustainable development (O)
- Competence building
- Participatory approach
- Technical transfer

64

nvironment impacts

Designing CDM project in consideration of the environment

Environment assessment

Cost & profits

65

- High growth rate and high potentiality
- Stimulate to protect forest degradation and deforestation
- Negative direction of land use changes

Emission reduction (urban area) ⟷ Carbon sequestration (rural area)

66

Conclusion

- To break through for the second commitment period.
- To utilize a huge capacity of tropical forest to mitigate global warming.
- To provide rural people with a channel to gain carbon credits.
- To facilitate rural people to join KP activities.

67

Clean Development Mechanism (CDM)

For a better understanding of the system and the modalities of the Clean Development Mechanism (CDM), the first two chapters provide the scientific basis of climate change and the existing framework for mitigation of climate change.

1. Scientific Basis of Climate Change[1]

1.1. IPCC

With an increasing concern on global warming and climate change, a wide range of scientific studies on climate change were conducted over the past decade. There is a general consensus that IPCC (Intergovernmental Panel on Climate Change) reports represent the best available and comprehensive evidence from the scientific community given knowledge and technological level at the point of time. IPCC was jointly established in 1988 by the World Meteorological Organisation (WMO) and the United Nations Environmental Programme (UNEP) in order to assess available information on climate change research and to provide scientific advice to the United Nations Framework Convention on Climate Change (UNFCCC)[2].

The publication of the Third Assessment Report (TAR) by IPCC in early 2001 brought about significant impact on people's perception towards our future. The rest of this chapter summarises the main conclusions of the TAR.

1.2. Warming world

The global average surface temperature (the average of near surface air temperature over land, and sea surface temperature) increased since 1861. Over the 20th century, the increase had been 0.6 ± 0.2°C (the top chart of Figure 1), which was about 0.15°C more than that estimated by the SAR[3] for the period up to 1994, owing to the relatively high temperatures from 1995 to 2000 and improved methods of data processing. These numbers take into account various adjustments, including urban heat island effects. The record showed a great deal of variability; for example, most of the warming occurred during the 20th century, during two periods, 1910 to 1945 and 1976 to 2000. Globally, it is very likely[4] that the 1990s was the warmest decade and 1998 the warmest year in the instrumental record since 1861 (see the top chart of Figure 1).

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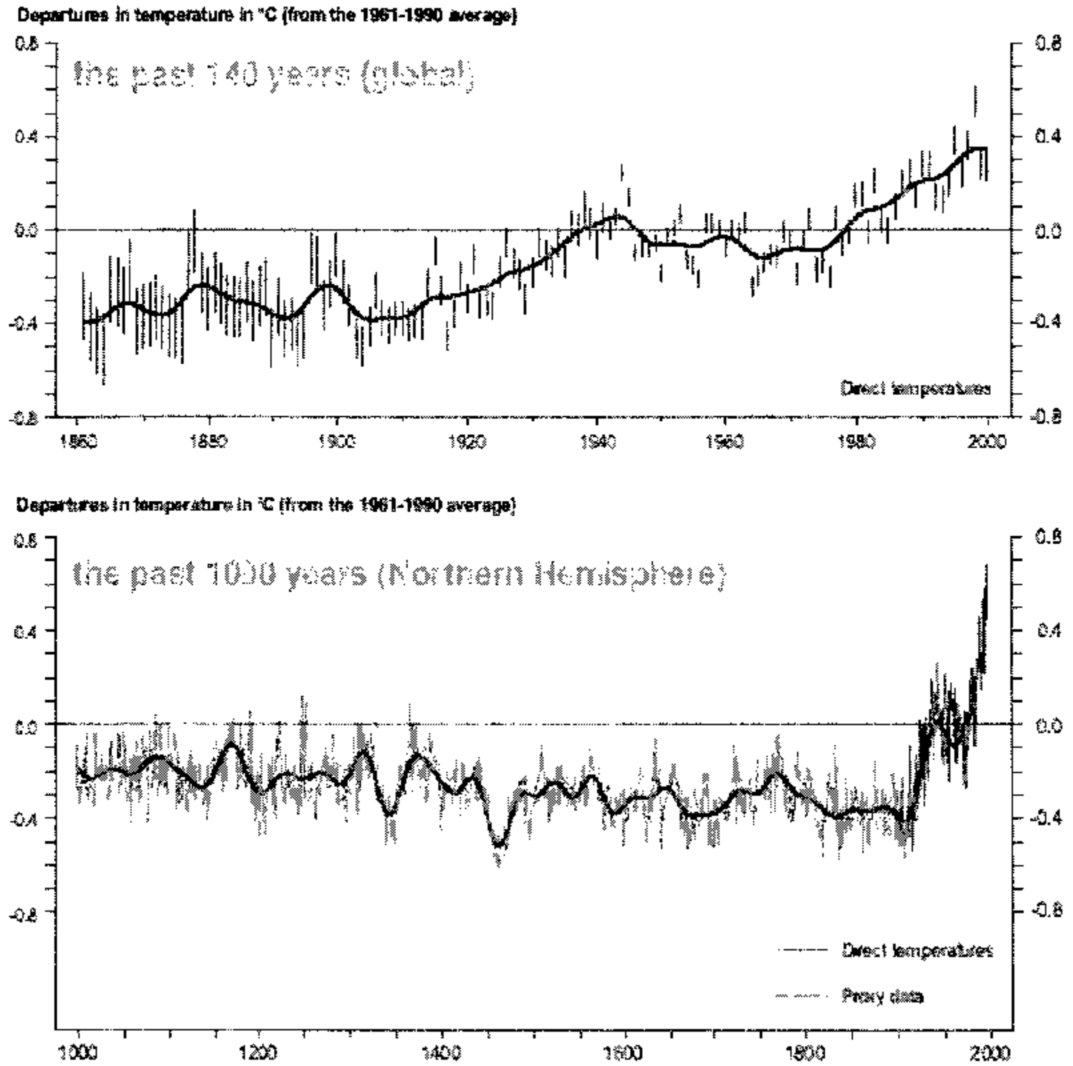
1 This section is largely taken form IPCC (2001).
2 The roles and the functions of the UNFCCC will be discussed later.
3 The SAR stands for The IPCC Second Assessment Report published in 1996.
4 The word "likely" in this chapter indicates an estimated confidential level of 66% - 90%.

Figure 1. Variations of the Earth's surface temperature for:



Source: IPCC (2001)

New analyses of proxy data for the Northern Hemisphere indicated that the increase in temperature in the 20th century was likely to have been the largest of any century during the past 1000 years. Because of limited data availability, however, far less is known about annual averages prior to 1000 years before the present and for conditions prevailing in most of the Southern Hemisphere prior to 1861. On an average, between 1950 and 1993, night-time daily minimum air temperatures over land increased by about 0.2°C per decade, which was about twice the rate of increase in daytime daily maximum air temperatures (0.1°C per decade).

The rise in temperature directly affected the areas of snow cover and ice extent. Satellite data showed that there was a decrease of about 10% in the extent of snow cover since the late 1960s, and ground-based observations showed that there was a reduction of about two weeks in the annual duration of lake- and river- ice cover in the mid- and high- latitudes of the Northern Hemisphere, over the 20th century. Since the 1950s, the extent of sea-ice in spring and summer of the Northern Hemisphere decreased by 10 to 15%. It is likely that there was about a 40% decline in Arctic sea-ice thickness during late summer to early autumn in recent decades and a considerably slower decline in winter sea-ice thickness.

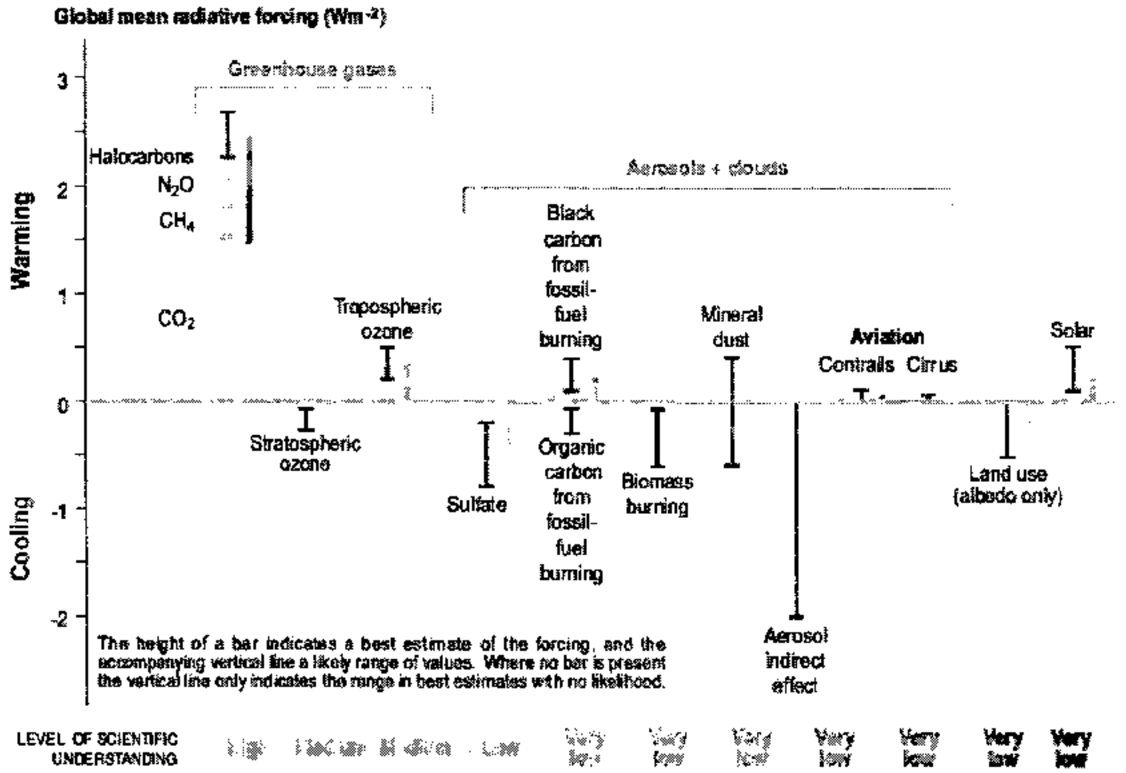
Moreover, global average sea level rose and ocean heat content increased. Tide gauge data showed that global average sea level rose between 0.1 and 0.2 metres during the 20th century. Global ocean heat content increased since the late 1950s, the period for which adequate observations of sub-surface ocean temperatures were available. In addition, several changes occurred in other important aspects of climate. For instance, precipitation had increased by 0.5 to 1% per decade in the 20th century over most mid- and high-latitudes of the Northern Hemisphere continents, and rainfall had increased by 0.2 to 0.3% per decade over the tropical (10°N to 10°S) land areas. In the mid- and high-latitudes of the Northern Hemisphere over the latter half of the 20th century, there was a 2 to 4% increase in frequency of heavy precipitation events. Increases in heavy precipitation events can arise from a number of causes, e.g., changes in atmospheric moisture, thunderstorm activity and large-scale storm activity.

Warm episodes of the El Niño-Southern Oscillation (ENSO) phenomenon (which consistently affects regional variations of precipitation and temperature over much of the tropics, sub-tropics and some mid-latitude areas) were more frequent, persistent and intense since the mid-1970s, compared with the previous 100 years. In some regions, such as parts of Asia and Africa, the frequency and intensity of droughts were observed to increase in recent decades.

1.3. Greenhouse gases (GHG) and Human Activities

Changes in climate occur as a result of both internal variability within the climate system, and external factors (both natural and anthropogenic). The influence of external factors on climate can be broadly compared using the concept of radiative forcing, which is a measure of the influence a factor has in altering the balance of incoming and outgoing energy in the Earth-atmosphere system. Figure 2 shows current estimates of the radiative forcing due to increased concentrations of atmospheric constituents and other mechanisms for the year 2000 relative to 1750.

Figure 2. The global mean radiative forcing of the climate system 1750 - 2000

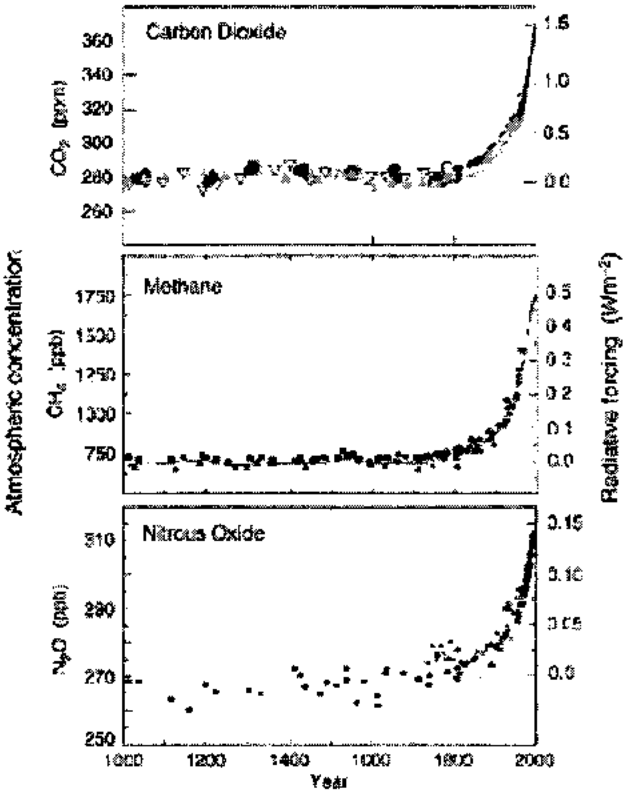


Source: IPCC (2001)

Figure 2 shows that the most powerful radiative forcing in the direction to warming, associated with the highest level of scientific understanding, comes from emissions of the greenhouse gases (GHG) such as CO_2 (carbon dioxide), CH_4 (methane), N_2O (nitrous oxide) and various halocarbon gases. As compared with the effects of GHG emissions, the effects of other radiative forces such as aerosols, clouds, land-use and solar are much smaller or negligible. The net effect of these radiative forces resulted in warming the global surface temperature.

The effects of the GHG emissions can also be recognised in Figure 3 which shows the global atmospheric concentrations of CO_2, CH_4 and N_2O over the past 1000 years.

Figure 3. Global atmospheric concentrations of GHGs *Source: IPCC (2001)*



The atmospheric concentration of carbon dioxide (CO_2) has increased by 31% since 1750. The present CO_2 concentration has not been exceeded during the past 420,000 years and likely not during the past 20 million years. The current rate of increase is unprecedented during at least the past 20,000 years. About three-quarters of the anthropogenic emissions of CO_2 to the atmosphere during the past 20 years were due to fossil fuel burning. The rest was predominantly due to land-use change, especially deforestation. Currently the ocean and the land together are taking up about half of the anthropogenic CO_2 emissions. On land, the uptake of anthropogenic CO_2 very likely exceeded the release of CO_2 by deforestation during the 1990s.

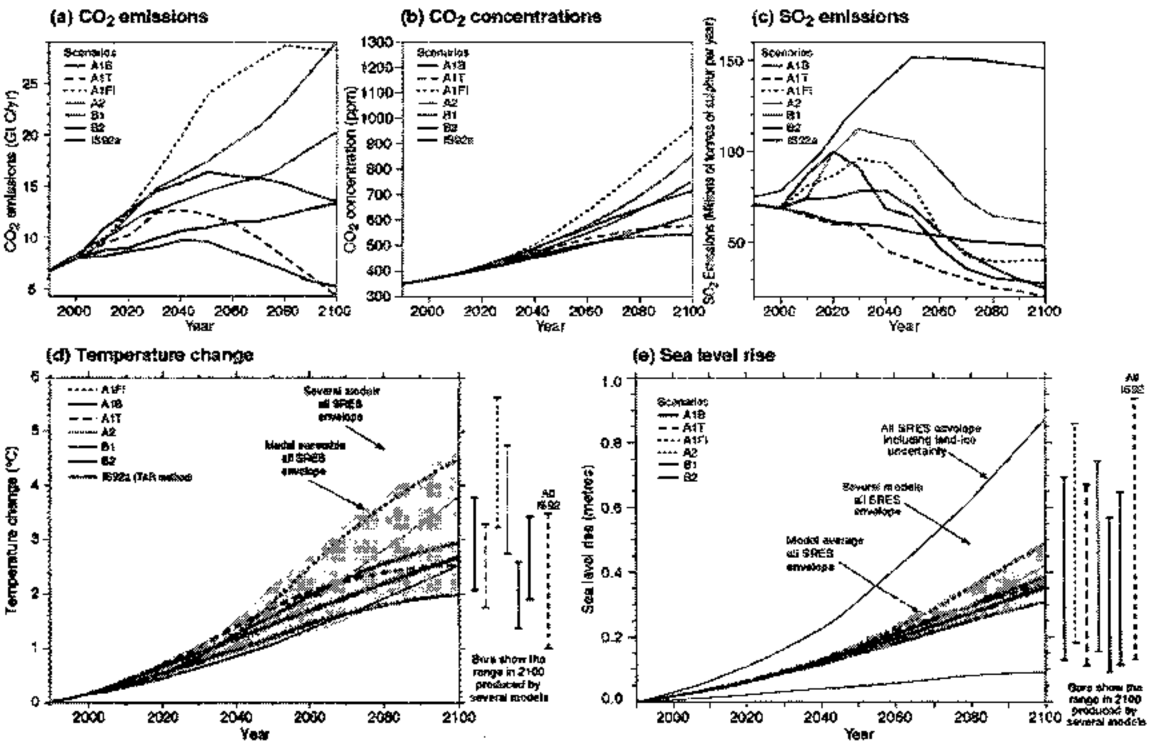
Similarly, the atmospheric concentration of CH_4 increased by 151% since 1750 and continues to increase. The present CH_4 concentration has not been exceeded during the past 420,000 years. Slightly more than half of current CH_4 emissions are anthropogenic (e.g., use of fossil fuels, cattle, rice agriculture and landfills). The atmospheric concentration of N_2O increased by 17% since 1750 and continues to increase. The present N_2O concentration has not been exceeded during at least the past thousand years. About a third of current N_2O emissions are anthropogenic (e.g., agricultural soils, cattle feed lots and chemical industry).

It is, therefore, quite evident that concentrations of atmospheric GHG and their radiative forcing continued to increase as a result of human activities. Thus, emissions of GHG due to human activities continue to alter the atmosphere in ways that are expected to affect the climate. In the light of new evidence and taking into account the remaining uncertainties, IPCC (2001) further emphasised that most of the observed warming over the last 50 years was likely to have been due to the increase in GHG concentrations. Furthermore, it is very likely that the 20th century warming contributed significantly to the observed sea level rise, through thermal expansion of sea water and widespread loss of land ice.

1.4. What would happen in the future?

Model simulation analysis predicts that human influence will continue to change the atmospheric composition throughout the 21st century. As a result, globally averaged surface temperature is projected to increase by 1.4 to 5.8°C [Figure 4(d)] over the next 100 years, no matter whether GHG emissions would increase or decrease [as seen in Figure 4 (a) and (c)] since such GHGs will eventually accumulate in the atmosphere over the century [see Figure 4 (b)].

Figure 4. The global climate of the 21st century



Source: IPCC (2001)

The results presented in Figure 4 are for the full range of emissions scenarios (A1FI, A1B and others[5]) based on a number of climate models. Figure 4 (d) indicates that the

5 For the detail of each scenario (so-called the SRES scenarios), see IPCC (2001), p.18.

projected rate of warming is much larger than the observed changes during the 20th century and is very likely to be without precedent during at least the last 10,000 years.

Table 1 depicts an assessment of confidence in projected changes during the 21st century. This assessment relies on observational and modelling studies, as well as the physical plausibility of future projections across all commonly-used scenarios and is based on expert judgement.

Table 1. Estimates of confidence in projected changes in extreme weather and climate event

Changes in phenomenon	Probabilities in changes (during the 21st century)
Higher maximum temperatures and more hot days over nearly all land areas	90 - 99%
Higher minimum temperatures, fewer cold days and frost days over nearly all land areas	90 - 99%
Reduced diurnal temperature range over most land areas	90 - 99%
Increase of heat index[6] over land areas	90 - 99% over most areas
More intense precipitation events	90 - 99% over most areas
Increased summer continental drying and associated risk of drought	66% - 90%
Increase in tropical cyclone peak wind intensities	66% - 90% over some areas
Increase in tropical cyclone mean and peak precipitation intensities	66% - 90% over some areas

Source: IPCC (2001)

Snow cover and sea-ice extent in the Northern Hemisphere are projected to decrease further. Glaciers and ice caps are projected to continue their widespread retreat during the 21st century. The Antarctic ice sheet is likely to gain mass because of greater precipitation, while the Greenland ice sheet is likely to lose mass because the increase in runoff will exceed the increase in precipitation. Furthermore, as Figure 4 (e) shows, global mean sea level is projected to rise by 0.09 to 0.88 metres between 1990 and 2100 for the full range of the scenarios. This is due primarily to thermal expansion and loss of mass from glaciers and ice caps.

Emissions of long-life GHG (i.e. CO_2, N_2O, PFCs, SF_6) have a lasting effect on the atmospheric composition, radiative forcing and climate. For example, several centuries

[6] Heat index: A combination of temperature and humidity that measures effects on human comfort.

after CO_2 emissions occur, about a quarter of the increase in CO_2 concentration caused by these emissions will still be present in the atmosphere. Therefore, increasing global mean surface temperature and rising sea level from thermal expansion of the ocean are projected to continue for hundreds of years after stabilisation of GHG concentrations (even at present levels).

1.5. GHG emissions

1.5.1. GHGs

The previous sections described that the biggest cause of climate change was GHG emissions generated by human activities. Table 2 summarises the characteristics of the main GHG[7] including their Global Warming Potentials (GWP)[8] which are measures of the relative radiative effect of a given substance compared to CO_2, integrated over a chosen time horizon.

Table 2. Main GHG and their Global Warming Potential (GWP)

GHG		Lifetime (years)	GWP	Main emission sources related human activities
Carbon dioxide	CO_2	5 - 200	1	Fuel combustion, industrial process
Methane	CH_4	12	21	Agriculture, landfill, gas leak, fuel combustion
Nitrous oxide	N_2O	114	310	Fuel combustion, agriculture, industrial process
HFC-23 (Hydrofluorocarbons)	CHF_3	260	11,700	By-product of HCFC-22, aerosol, CFC substitution
HFC-134a (Hydrofluorocarbons)	CH_2F CF_3	13.8	1300	CFC substitution, aerosol
PFC-116 (Perfuluorocarbons)	C_2F_6	10,000	9,200	Industrial process
Sulphur hexafluoride	SF_6	3,200	23,900	Industrial process

Source: IPCC (1996), IPCC (2001)

Among GHG, CO_2 accounts for 60% of global warming effects while CH_4, N_2O and others (hydrofluorocarbons etc.) account for 20%, 6% and 14% respectively. In fact, the absolute levels of non-CO_2 GHG emissions are estimated to be much less than that of CO_2. However, the substantially larger GWP associated with non-CO_2 GHG make them significant. Nonetheless, it is clear that CO_2 emissions are the predominant contributor for global warming.

[7] The GHG referred here are the "target gases" under the Kyoto Protocol.

[8] GWP referred here are applied under the Kyoto Protocol and are based on SAR (IPCC, 1996) rather than TAR (IPCC, 2001).

1.5.2. GHG emissions in the world

Figure 5. World CO_2 emissions by the region

Source: IPCC (2001)

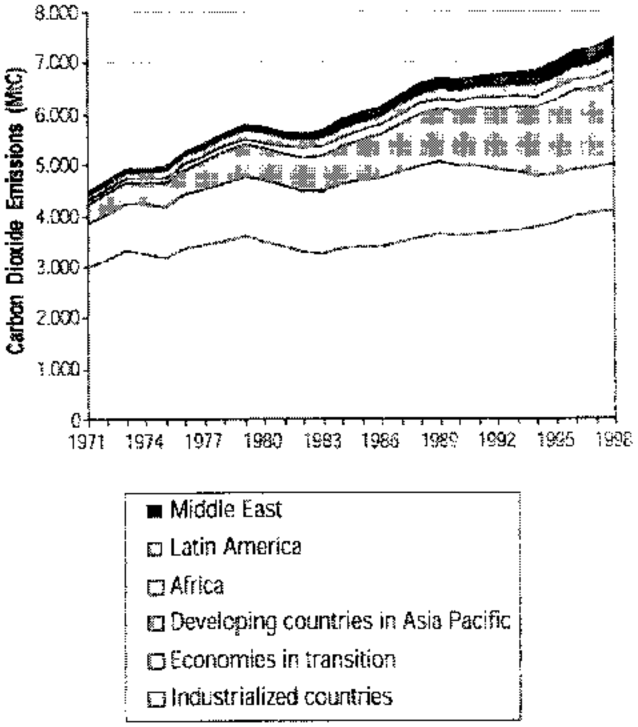
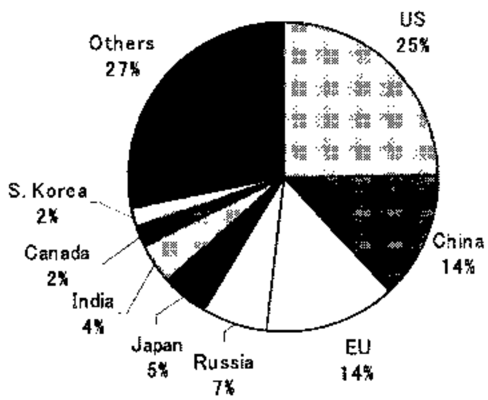


Figure 5 shows the CO_2 emissions in the world since 1971 up to 1998, which increased almost twice during the period. Although the dominant position of the emissions from industrialised countries remains constant throughout the period, it can be seen that the shares from the developing countries, particularly from the Asia and Pacific region, considerably increased over the past 20 years. In contrast, the share of the countries in economic transition (such as Russia) largely contracted during the early 1990s.

Figure 6. Shares of CO_2 emissions by countries (2000)

Source: EDMC (2003)



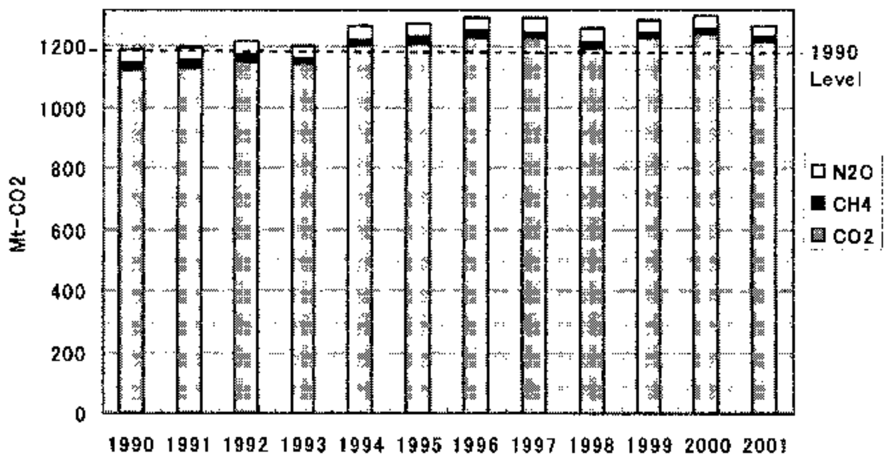
The breakdown of the world CO_2 emissions by countries in 2000 is shown in Figure 6. The US predominates by contributing a quarter of the world emissions. China, Russia and India are big emitters due to their large population and land area. As a single country, Japan ranks the forth largest CO_2 emitter in the world. Note that the eight large emitters account for almost 75% of the world CO_2 emissions.

Compared to CO_2 emissions, which can be traced relatively well from fossil fuel consumption, the total amounts of non-CO_2 GHG emissions in the world are less accurately known. Nevertheless, recent estimates indicate that most of these non-CO_2 GHG have been increasing over the past decade and the share of emissions from developing countries is generally more than that of CO_2.

1.5.3. GHG emissions in Japan

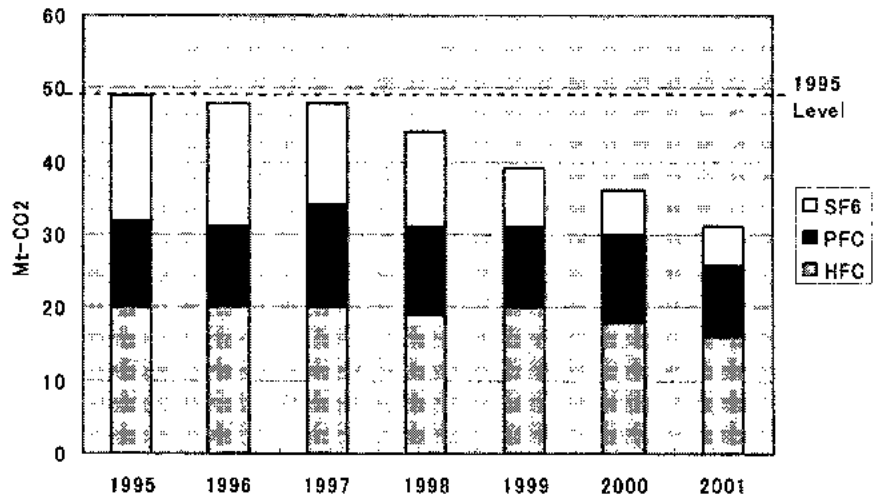
GHGs emissions in Japan are depicted in Figure 7 and 8 below.

Figure 7. CO_2, CH_4 and N_2O emissions in Japan 1990 - 2001



Source: Ministry of the Environment, Japan (2003)

Figure 8. HFCs, PFCs and SF_6 emissions in Japan 1995 - 2001



Source: Ministry of the Environment, Japan (2003)

Figure 7 shows that CO_2 emissions increased by 8% between 1990 and 2001 whereas CH_4 and N_2O slightly declined during the same period. The vast majority of GHG emissions in Japan are dominated by CO_2 emissions, nearly 95% of which relate to energy use. Therefore, reduction of GHG emissions in Japan is directly linked to the control of energy demand. Since sufficient data are unavailable, emissions of HFC, PFC and SF_6 are shown only after 1995. A substantial reduction (a third) in such GHG was observed over the past few years mainly due to improvements in industrial process. Although their actual emissions are very small as compared with those of CO2, emission reduction is notable due to their extremely high GWP and longer lifetime (recall Table 2).

2. International Political Regime to address Climate Change

2.1 UNFCCC

The establishment of the United Nations Framework Convention on Climate Change (UNFCCC) was recognised as the first stage of creation of a political and legal framework at the international level to address climate change. UNFCCC, currently with a membership of 188 countries, was adopted at the Rio Earth Summit in 1992 and it came into force in 1994. The official meeting of all parties joining UNFCCC is normally held every year and is called the COP (Conference of the Parties)[9]. Under COP, there are two subsidiary bodies - the Subsidiary Body for Scientific and Technological Advice (SBSTA) and the Subsidiary Body for Implementation (SBI) - to provide the COP with relevant information and advice on specific issues. Both SBSTA and SBI comprise government representatives and are normally held simultaneously twice a year.

The objective of the UFCCC is clearly stated in Article 2 that:

The ultimate objective of this Convention ...... is to achieve ...... stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner.

Article 2 means that the countries joining the treaty agree to make their earnest efforts

[9] The latest COP was the 9th sessions (COP9) which was held at Milan, Italy, in December 2003.

for reducing GHG emissions substantially to stabilise GHG concentrations in the atmosphere. Another important principle in the UNFCCC is "***common but differentiated responsibilities***" among the countries. According to this principle, the developed countries should take the lead in addressing climate change. The developed counties are referred to as "Annex I countries" in UNFCCC (Table 3).

Table 3. Annex I in UNFCCC (United Nations, 1992)

Australia	Japan
Austria	Latvia
Belarus	Lithuania
Belgium	Luxembourg
Bulgaria	Netherlands
Canada	New Zealand
Czechoslovakia	Norway
Denmark	Poland
European Economic Community	Portugal
Estonia	Romania
Finland	Russian Federation
France	Spain
Germany	Sweden
Greece	Switzerland
Hungary	Turkey
Iceland	Ukraine
Ireland	United Kingdom
Italy	United States of America

Under UNFCCC, there are a number of commitments applicable particularly for Annex I countries. For instance, Annex I countries should reduce their GHG emissions to the level of 1990 by 2000. In addition, Annex I countries should report regularly about their GHG emissions, future profiles, and detailed information on their policies and measures to mitigate climate change. Nonetheless, these commitments are sometimes called as "soft commitments" as they are not legally binding, i.e., no penalty is applied for countries which do not comply with the commitments. Therefore, there seems to be a general agreement that UNFCCC does not have enough enforcement mechanism over the developed countries. Moreover, UNFCCC did not specify any commitments on how much GHG emissions should be reduced after 2000.

In fact, throughout the 1990s, GHG emissions from most of the developed countries steadily increased except for the former Soviet Union, Eastern Europe, and a few Western European countries such as the UK and Germany. For example, CO_2 emissions in Japan during the 1990s grew by 8%, and those of the US and Canada increased by 18% and 20% respectively. However, these facts do not necessary suggest that UNFCCC is an unsuccessful treaty. Rather, UNFCCC can be considered a significant step as seen from at least two dimensions. First, the ultimate objectives and basic principles of UFCCC provide essential foundation for subsequent diplomatic agreements. Second, the modalities and institutional framework established under UNFCCC offer the main framework for climate change negotiations (Oberthur and Ott, 1999). Again, it is true that commitments specified in UNFCCC are "soft binding" and are not adequate enough in the long-term. However, it should be emphasised that UNFCCC opened the road towards future progress in addressing global climate change issues. Therefore, it is only natural that the next step is to establish strengthened and binding commitments in order to realize the main objective of UNFCCC - stabilisation of GHG emissions in the atmosphere at a safe level.

2.2 Kyoto Protocol and Marrakech Accord

At the first UNFCCC meeting (COP1) in 1995 in Berlin, an important decision that is now known was "the Berlin Mandate", was agreed upon by the member countries. The Mandate pronounced that the commitments in UNFCCC are not adequate and the strengthening of commitments of Annex I countries is necessary for the period beyond 2000. Therefore, it was decided that quantified limitation of GHG emissions from Annex I countries should be adopted at the third meeting of UNFCCC (COP3) in 1997. Following the adoption of the Berlin Mandate in 1995, a large number of meetings including COP2 were held to continue long political negotiations in order to set new commitments limiting GHG emissions from Annex I countries[10]. The Kyoto Protocol was eventually adopted in December 1997 in Kyoto, Japan.

The Kyoto Protocol itself does not stipulate the detailed modalities and procedures for various components in the protocol. In fact, it required another four years to complete a full set of modalities and procedures to implement the protocol in COP7 as the Marrakech Accord. The subsequent sections outline the important components of the Kyoto Protocol as well as its modalities and procedures stated in the Marrakech Accord.

2.2.1 GHG emissions reduction targets under the Kyoto Protocol

The commitment of the Kyoto Protocol is described in its Article 3, which defines the reduction targets of GHG emissions from the developed countries between 2008 and 2012 and allocated specifically to each country as binding commitments. Article 3.1 of the Kyoto Protocol states:

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[10] For the details of the negotiation process towards the Kyoto Protocol, see Grubb *et al.* (1999) and Oberthur and Ott (1999).

The Parties included in Annex I shall, individually or jointly, ensure that their aggregate anthropogenic carbon dioxide equivalent emissions of the greenhouse gases ... do not exceed their assigned amounts, calculated pursuant to their quantified emission limitation and reduction commitments inscribed in Annex B....., with a view to reducing their overall emissions of such gases by at least 5 per cent below 1990 levels in the commitment period 2008 to 2012.

Table 4 summarises the GHG emission reduction targets as percentages relative to the base year (1990) emissions described in Annex B in the protocol. Annex B in the Kyoto Protocol is based on Annex I in UNFCCC (Table 2) with minor changes. Annex B excludes Turkey, Belarus and Czechoslovakia among the countries listed in Annex I, while it includes Croatia, Liechtenstein, Monaco, Slovenia, Czech Republic and Slovakia[11].

GHG referred to in the Kyoto Protocol are six particular gases (as already shown in Table 2) including CO_2, CH_4, N_2O, hydrofluorocarbons (HFC), perfluorocarbons (PFC), sulphur hexafluoride (SF_6). The amount of these gases are aggregated and put together in a "basket" using the Global Warming Potentials (GWPs) (Column 3 in Table 3). The **assigned amounts** listed in Article 3 are calculated from the base year emissions of these GHG with GWP and the commitment targets in Table 4. The base year is set to be 1990 for CO_2, CH_4 and N_2O emissions, while 1995 can be chosen as an alternative especially for HFC, PFC and SF_6[12]. There are some exceptions for counties in transition (EITs: the former USSR and the East European countries) to choose their base year other than 1990 taking into account the substantial decline in their GHG emission.

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11 Despite various differences, "Annex I" " (rather than "Annex B") is referred to more frequently to mean the developed countries. Therefore, throughout this paper, Annex I will be used for referring the developed countries which have emissions reduction targets listed in Annex B of the Kyoto Protocol.

12 The Japanese government, for example, decided to choose 1995 as a base year for non-CO_2 gases.

Table 4. GHG emissions reductions targets in the Kyoto Protocol, Annex B

Country	Requited reductions in GHG emissions
EU total*	-8%
Portugal	27%
Greece	25%
Spain	15%
Ireland	13%
Sweden	4%
Findland	0%
France	0%
Netherlands	-6%
Italy	-6.5%
Belgium	-7.5%
UK	-12.5%
Austtria	-13%
Denmark	-21%
Germany	-21%
Luxembourt	-28%
Economy in Transition (EIT) Coutnrires**	
Russia	0%
Ukraine	0%
Hungary	-6%
Poland	-6%
Bulgaria	-8%
Czech Republic	-8%
Estonia	-8%
Latvia	-8%
Lithuania	-8%
Romania	-8%
Slovakia	-8%
Slovenia	-8%
Croatia***	-5%

Country	Requited reductions in GHG emissions
Other countries	
Iceland	10%
Austraria	8%
Norway	1%
New Zealand	0%
Canada	-6%
Japan	-6%
USA	-7%
Swithland	-8%
Liechtenstein	-8%
Monaco	-8%

Notes to Table 4:

* The target for total EU was redistributed to each EU member country under the Protocol's provision.
** The EIT countries were given specific base year rather than 1990 applied for other countries.
*** Base year for Croatia is still under negotiation.

2.2.2. Assigned Amount

The assigned amount is an important concept to understand the commitment system under the Kyoto Protocol. It indicates the maximum amount of its emissions which is initially allocated for each Annex I country during the period from 2008 to 2012 (the first commitment period)[13] based on emission reduction targets listed in Annex B (see Table 4). Each Annex I country shall issue a quantity of emissions allowances equivalent to its assigned amount, which is equal to the emissions level allowed by

[13] The Kyoto Protocol does not provide emission reduction targets after the first commitment period and this issue will be discussed in future COP meetings.

Annex B (see Table 4) multiplied by five in its national registry[14]. Such emission allowances are referred to as "AAU" or "Assigned Amount Unit". In order to comply with the emission reduction targets, each Annex I country, in principle, should have a certain amount of AAU in its national registry as much as the amount of the country's GHG actually emitted during the five years between 2008 and 2012. In other words, the compliance assessment shall be based on the comparison of the quantity of AAUs with its aggregated GHG emissions. If necessary, AAUs can be carried over to the next commitment period without any restriction.

Moreover, as will be explained in subsequent sections, there are several ways for Annex I countries to make some changes to the assigned amount in order to increase their amount of emission allowances towards accounting of compliance needs of the commitment period. They include counting additional allowances generated from carbon sinks by forestry activities (LULUCF) and an acquisition of allowances (such as AAUs) from other countries through the Kyoto Mechanisms. Therefore, Annex I countries are given some flexibility when actual emissions are compared with the quantity of emissions allowances in their national registry.

[14] National registry should be established in each Annex I country to ensure the accurate accounting of the issuance, holding, acquisition and other transactions of the emissions allowances. Further details of the national registry are given in later sections.

1 # Introduction to CDM: Modalities and Procedures

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2 ## Contents

- UNFCCC
- Kyoto Protocol and Marrakech Accord
- Kyoto Mechanisms
  - Functions of national registry
- Clean Development Mechanism (CDM)
  - Overview
  - Baseline and monitoring methodologies
  - Case study
  - DOE
  - Small scale CDM

3 ## UNFCCC, Kyoto Protocol, Kyoto Mechanisms and Marrakech Accord

4 ## UNFCCC

- Adopted at Rio Summit in 1992
- Entered into force in 1994
- 188 countries join
- The objective of UNFCCC (Art. 2)

  The ultimate objective of this Convention ... is to achieve ... stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system.

5 ## UNFCCC

- COP1(Berlin,1995): "Berlin Mandate"
- COP3(Kyoto,1997): "Kyoto Protocol"
- COP7(Marrakech,2001): "Marrakech Accord"
- COP9(Milan, 2003): AR-CDM modalities
- COP10(Buenos Aires, 2004): ???

6 ## Kyoto Protocol

- Adopted in COP3 (Kyoto) in 1997
- Details of modalities and procedures for implementation of Kyoto Protocol were finally stipulated in Marrakech Accord

(2001) at COP7
- Annex B specifies GHG emissions targets for each Annex I country for 1st commitment period (2008-2012)

7 Annex B in Kyoto Protocol

8 GHGs referred in Kyoto Protocol

- CO_2 (Carbon Dioxide) GWP:1
- CH_4 (Methane) GWP:21
- N_2O (Nitrous oxide) GWP:310
- Hydrofluorocarbons (HFCs) GWP:11700*
- Perfluorocarbons (PFCs) GWP:9200**
- Sulphur hexafluoride (SF_6) GWP:23900

*HFC-23 case
**PFC-116 case

9 Compliance assessment system under Kyoto Protocol

10 Assigned amount

- Assigned amount = (Base year (e.g. 1990) actual emissions − reduction target (e.g. 6%) in Annex B) × 5 (years)
- Assigned amount is an unique fixed number given to each Annex I country throughout the commitment period
- AAU (Assigned Amount Unit) shall be issued (at equivalent amount to the assigned amount) in its national registry
- Additional credits (by Kyoto Mechanisms, sinks by forest activities) can be added or subtracted to/from the assigned amount

11 Kyoto Mechanisms

- Emissions trading (ET)
- Clean Development Mechanism (CDM)
- Joint Implementation (JI)
  - Annex I country can use these Kyoto Mechanisms to comply with its reduction target specified in Annex B
  - Modalities and procedures for Kyoto Mechanisms are prescribed in Marrakech Accord (2001), not in KP itself.

12 Emissions Trading (1)

13 Emissions Trading (2)

- Units and credits (AAU, CER, ERU, RMU) can be traded between Annex I countries in order to fulfil their reduction targets
- Annex I countries can reduce their total costs of emissions reduction through emissions trading
- However, the total amount of reduction in Annex I countries remains constant

14 Clean Development Mechanism (CDM)

15 Clean Development Mechanism (CDM)

- Annex I countries can acquire CER (Certified Emission Reduction) by investing in emission reduction projects (e.g. energy efficiency improvement etc) implemented in Non-Annex I countries
- CER can be added to the assigned amount of the Annex I (investor) country so that the country can emit GHG additionally as much as the CDM project reduce.

16 Joint Implementation (JI)

17 Joint Implementation (JI)

- Annex I countries acquire ERU (Emission Reduction Unit) by investing in emission reduction projects implemented in other Annex I countries.
- ERU can be added to the assigned amount of the Annex I (investor) country so that the country can emit GHG additionally as much as the JI project reduce.

18 Sinks by forestry activities

- The net changes in GHG by sinks resulting from land-use, land-use change and forestry (LULUCF) activities can be used to meet the Kyoto targets.
- RMU (ReMuval Unit) equivalent to the net removal shall be issued in its national registry
- LULUCF activities are limited to: Afforestation, reforestation, deforestation, revegetation, forest management, cropland management, grazing land management (during 2008-2012 but started since 1990)

19 Sinks by forestry activities

- The maximum amount of RMUs resulting from forest management added to the assigned amount are limited to:
  - Japan: 13 MtC/year
  - Russia: 33 MtC/year
  - Canada:12 MtC/year
  - France: 0.88 MtC/year
  - Germany: 1.24 MtC/year
- These apply to 1st C.P. only

20 Accounting units and credits under Kyoto Protocol

21 Carry over of units/credits to 2nd c.p.

- AAU: all of AAUs, not retired or cancelled, can be carried over
- CER: Up to 2.5% of the assigned amount, not retired or cancelled, can be carried over
- ERU: Up to 2.5% of the assigned amount, not retired or

cancelled and not converted from RMU, can be carried over
- RMU: Cannot be carried over at all

22 National registry under KP

- A standardized electronic database for recording and tracking of units and credits (AAUs, CERs, ERUs and RMUs)
- Each Annex I county must establish its own national registry
- Necessary for accurate accounting of issuance, holding, transfer, acquisition, cancellation and retirement of AAUs, CERs, ERUs and RMUs

23 National registry under KP

- Each national registry must have:
  - Holding account for the country
  - Holding account for each legal entity authorised by the country
  - Cancellation account
  - Retirement account
- Each account within a national registry has a unique account number
- Units/credits (AAU, CER etc) can be transferred between/within registries.
- All the transactions between registries are monitored and verified by an electric transaction log

24 Structure of a national registry under KP

25 CDM Registry for CER

- CERs generated by a CDM project shall be originally issued into the pending account the CDM registry
- CERs corresponding to the share of proceeds to cover administrative expenses and costs of adaptation (share of proceeds) shall be removed to the another account of the CDM registry
- The remaining of CERs are moved from the CDM registry to the registry account of country and CDM project participants involved upon request
- Otherwise, CERs are left in the pending account of the CDM registry.

26 Registry system under KP

27 AAU and RMU issuance

28 Transfers and acquisitions of units/credits by emissions trading

29 Retirement and carry-overs of units/credits

30 ERU issuance by JI project

31 CER issuance (into the CDM registry) and transfer to N.R.

32 Cancellation of units/credits to strengthen targets

33 Unique serial numbers for units/credits

34 Unique account numbers in

a national registry

35 Requirements to use emissions trading

- Country
  - Ratification of the Kyoto Protocol
  - Annex I countries only
  - Assigned amount is calculated
  - Having a national system for accounting GHG emissions and sinks
  - Establishment of a national registry
  - Annual submission of GHG inventory report
- Legal entity
  - Authorised by a country which fulfils the above requirements to use the Kyoto Mechanisms
  - Having a holding account in a national registry

36 Conditions on Kyoto Mechanisms

- Commitment reserve (for ET only)
  - Annex I countries must remain, in their national registry, AAUs which should not be drop below 90% of their assigned amount or 5 times of their most recent GHG emissions, whichever is lowest
- Supplementary condition
  - Use of the Kyoto mechanisms should be supplemental
  - Therefore, domestic policies and measure to reduce GHG emissions should constitute a significant element

37 Penalties for non-compliance country

- The country's assigned amount for 2nd c.p. will be reduced by (excess amount of emissions during 1st c.p. × 1.3)
- The country is suspended from transferring AAU, CER, ERU, RMU to other country through the emissions trading
- AAU, CER, ERU, RMU in the national registry of the country cannot be carried over to 2nd c.p.
- Compliance or not (for 1st c.p.)...will be clear by mid-2015

38 Clean Development Mechanism (CDM)

39 CDM overall view

40 Definition of CDM: Kyoto Protocol Art. 12 states...

- Clean development mechanism shall be to assist Non-Annex I Parties in achieving sustainable development and in contributing to the ultimate objective of the Convention
- And to assist Annex I countries in achieving compliance with their quantified emission limitation and reduction commitments

41 What can be CDM project? (1)

- There is no detailed specification in Kyoto protocol and Marrakech Accord
- In principal, whatever projects, which contribute to sustainable development in Non-Annex I countries, can be registered as CDM

projects

- "Contribution to sustainable development" can be considered individually depending upon Non-Annex I countries to host CDM projects

42 What can be CDM project? (2)

- There are a number of qualifications
  - Annex I countries should refrain from using CERs generated from nuclear facilities
  - LULUCF CDM activities limits to afforestation and reforestation (AR)
  - Only less than 1% of CERs from AR-CDM can be used to the compliance assessment.
  - Public funding for CDM is not result in the diversion of ODA, and is be separate from the financial obligations of Annex I counties
  - Should have written approvals from both host and donor countries

43 Participation requirements in CDM (for country)

- Participation is voluntary
- Ratification of the Kyoto Protocol
- Establishment of Designated national authority for CDM (DNA)
- In addition, for Annex I country:
  - Calculation of its assigned amount
  - Establishment of its national registry
  - Establishment of GHG inventory system

  .....similar to the requirements for E.T.

44 Participation requirements in CDM (for legal entities)

- Both host and donor countries involving CDM approve legal entity's participation
- For acquisition of CER, the country to approve the CDM project fulfil the participation requirements, and the legal entity must have a holding account in the national registry of the country
- Otherwise, CERs are hold in the pending account in the CDM registry

45 CDM related organisations (1)

- COP/MOP (Conference of the Party serving as the Meeting of the Party to the Kyoto Protocol):
  - provides overall guidance to the CDM based on recommendations from the CDM executive board
- CDM executive board (CDM-EB):
  - Consists of 10 members
  - supervises and manages the CDM under the guidance of COP/MOP
  - Approves new baseline and monitoring methodologies
  - Be responsible for the accreditation of operational entities
  - Develops and maintains the CDM registry

46 CDM related organisations (2)

- Expertise panels under CDM-EB
  - Methodology panel (Meth panel) : for examination of newly proposed baseline and monitoring methodologies
  - Accreditation panel (CDM-AP): for accreditation of operational entities
    - CDM-AT: CDM accreditation team
  - Small scale CDM (SSC-CDM) panel: for modalities and procedures for

SSC-CDM (have seemed to finalise its task by COP8)

47 CDM related organisations (3)

- Designated operational entities (DOE):
  - Validate proposed CDM project activities
  - Verify and certify emissions reductions occurred by CDM project activities
  - Must be independent from CDM participants
  - Must be accredited by CDM-EB and designated by COP/MOP

48 CDM project cycle

49 CDM project approved by JPN gov.

- Brazil: Biomass fuel switch in steel production (0.13 Mt-CO2)
- Thailand: Biomass power station using rubber timber (0.06Mt-CO2)
- S.Korea: HFC-23 decomposition (1.4 Mt-CO2)
- Bhutan: SSC hydro power (500 t-CO2)
- Vietnam: Oil field associated gas recovery (0.68 Mt-CO2)

50 CDM Project Design Document (CDM-PDD)

A) General description of project activity
B) Baseline methodology*
C) Duration of the project activity/Crediting period
D) Monitoring methodology and plan*
E) Calculations of GHG emissions by sources
F) Environmental impacts*
G) Stakeholders comments

<u>Annexes</u>

1. Information on participants in the project activity
2. Information regarding public funding
3. New baseline methodology (if it is not approved yet)*
4. New monitoring methodology (if it is not approved yet)*
5. Baseline data*

* For SSC-CDM, these items are simplified or not required

51 Crediting period

- Crediting period: the period at which CER credits are generated as results of CDM project activities
- Project participants can select one of the following options alternatively:
  - Max. 7 years which may be renewed at most two times
  - Max. 10 years with no option of renewal

52 Baseline methodology (1)

- Baseline: Estimated GHG emissions which would have occurred in the absence of the CDM project activity
  - Directly affects the amount of CERs generated by the CDM project → Critical part in PDD
- CDM project must be <u>additional to B.L.</u>
- <u>Additionality must be proved</u> in PDD
- Baseline must be approved by CDM-EB (after an examination of Meth-panel)
- Policies and situations in host country should be reflected in consideration of baseline setting

53 Baseline methodology (2)

- One of the following baseline methodologies should be selected
  - Existing actual or historical emissions
  - Emissions from a technical that represents an economically attractive course of action, taking into account barriers to investment
  - The average emissions of similar project activities under taken in the previous five years, in similar social, economic, environmental and technological circumstances, and whose performance is among the top 20% of their category

54 Approval process of new baseline (1)

- Newly proposed baseline must be submitted to Meth-panel for an examination
  - Approved baselines methodologies can be used without re-submission
  - Approved baselines currently available
    - AM0001: HFC-23 decomposition (S. Korea)
    - AM0002: Landfill gas capture (Brazil)
    - AM0003: Landfill gas capture and electricity generation (Brazil)
    - AM0004: Rice husk power station (Thailand)
  - Unless otherwise, all projects must propose their own new baseline methodologies for approval

55 Approval process of new baseline (2)

- Out of 36 proposals so far submitted, only 9 passed the Meth-panel, and only have finally approved by CDM-EB
- Rest of the proposals are needed to re-submit again and again until approvals are obtained

>> Complex process

- As time goes by, approved baseline methodologies will be accumulated

>> becomes easier process in the future?

56 Monitoring meth. and plan (1)

- The way to monitor and assess actual GHG emissions from CDM project (after CDM project is implemented)
- Differences between monitored GHG emissions and baseline (set at PDD) are the amount of CERs >> Critical
- Same as the baseline case, monitoring methodology also must be approved by CDM-EB

57 Monitoring meth. and plan (2)

- Monitoring plan should provide for:
  - Collection all relevant data necessary for estimating, determining or measuring baseline/emissions during the crediting period
  - Collection of increased emissions outside the project boundary that attributable to the project during the crediting period
  - Collection of information relevant to analysis of environmental impacts of CDM project activity
  - Quality assurance and control procedures for the monitoring process
  - Procedures for periodic calculation of reduction by CDM project, and for leakage effects

58 Approval process of

new monitoring methodology (1)

- A parallel process to the approval process of the baseline methodology
- Only 4 methodologies have been approved by CDM-EB
- Need for submission of monitoring methodologies as well as baseline until both of them are approved
  >> a tough process for the moment

59 Baseline and monitoring meth.: Approval process by CDM-EB (1)

1. Biomass co-generation (Brazil): A
2. Fuel switching in stell production (Brazil): C
3. CO2 reduction from chemical process (Trinidad and Tobago): C
4. Landfill gas recovery (Brazil): A
5. Landfill gas recovery (Brazil): A
6. Hydro power station (Guatemala): C
7. HFC-23 decomposition (S. Korea): A
8. Hydro power station (Costa Rica): C
9. Biomass power station (Thailand): C
10. Landfill gas recovery and power st. (S. Africa): A

60 Baseline and monitoring meth.: Approval process by CDM-EB (2)

11. Biomass power station (India): C
12. Wind power station (Jamaica): B
13. Methane recovery and power st. (Malaysia): ?
14. Biomass power station (Thailand): C
15. Biomass power station (Thailand): C
16. Fuel switching in food factory (Chile): A
17. Energy eff. improvement at oil refinery (China):?
18. Co-generation by natural gas (Chile): ?
19. Biomass power station (Thailand): A
20. Hydro power station (Colombia): ?

61 Baseline and monitoring meth.: Approval process by CDM-EB (3)

21. Landfill gas recovery (Brazil): A
22. Methane recovery (Chile): ?
23. Hydro power station (Mexico): A
24. Wind power station (Columbia): ?
25. Biomass power station (India): ?
26. Oil field associated gas recovery (Vietnam): ?
27. Biomass power station (Brazil): ?
28. Fuel switching (coal → biomass) (India): ?
29. Fuel switching in stell production (Brazil): C
30. Energy eff. improvement at power st. (India): ?

62 Baseline and monitoring meth.: Approval process by CDM-EB (4)

31. Exhaust gas recovery and power st. (India): ?
32. Methane recovery and power st. (India): ?
33. Energy eff. improvement at cement factory (Costa Rica): ?

34. Methane recovery and power st. at livestock (Brazil): ?
35. Biomass power station and co-gene. (India): ?
36. Wind power station (Egypt): ?

63 Case study: HFC-23 decomposition CDM project: Outline

- Project outline
  - Additional installation of HFC-23 collection and decomposition equipments to the currently operating HCFC-22 manufacturing plant of Ulsan Chemical Co.Ltd. in S. Korea
  - HFC-23 is generated as a by-product of HCFC-22 production
  - HFC-23: GWP 11700

  >> very strong global warming power

64 Case study: HFC-23 decomposition CDM project: Outline

- Project participants
  - Host country (S. Korea): FIRSTEC Co. Ltd. (a group company of Ulsan Chemical Co. Ltd)
  - Donor country (Japan): INEOS Flour Japan Ltd (Tokyo, Japan)
- DOE (planned): Japan Quality Assurance Organization (JQA)
- "A" rank assessment was given from CDM-EB to the baseline and monitoring methodologies in this project for the first time in the world

65 Case study: HFC-23 decomposition CDM project: Outline

- Planned GHG emissions reduction: 1.4 Mt-CO2
  - Due to very high GWP, CERs acquired in this project (in CO2 equivalent) is very large
  - Highly profitable CDM project compared to its initial investment cost
- Crediting period: 7 years (may be renewed twice later) starts at 1^{st} April 2004
- No ODA is used >> ODA problem is cleared
- Life time of the project: 30 years >> finishes before starting HCFC-22 regulation under the Montreal Protocol

66 Case study: HFC-23 decomposition CDM project: Baseline setting

- Baseline approach selected: Existing actual or historical emissions
- Production/consumption of HFC-23 and HCFC-22 are not regulated at all under the current law in S. Korea.
- There is no economic incentive for Ulsan Chemical Co. Ltd. to invest HFC-23 decomposition equipment which entails significant capital and operating costs.
- Therefore, <u>this CDM project is additional</u>

  >> Principals for required additionality are clearly stated in PDD

67 Case study: HFC-23 decomposition CDM project: Baseline setting

- HFC-23 decomposed per HCFC-22 production amount: "Cut-off" condition
  - Set at the lowest latest annual historical data (2.9%) over the past three years in the same plant
  - IPCC GPG is set at 4%
  - Ensure conservativeness to set baseline
    - Use IPCC GHG as a safety valve if actual "cut-off" is higher than IPCC GPG value
    - Additional HFC-23 resulting from decrease in efficiency will not be counted for CERs
    - "Cut-off" value will be monitored and checked
- Explanation for existing barrier to CDM and conservative baseline setting → successfully passed CDM-EB's assessment

68 ## Case study: HFC-23 decomposition CDM project: Monitoring

- Monitoring methodology and plan are explained in PDD as followed
  - Directly measurable HFC-23 inputs to be destroyed in the decomposition plant (=emissions reduction in this CDM project)
  - Project boundary is limited to the decomposition plant (emissions outside the plant is excluded from B.L.)
  - Emissions within the project boundary
    - CO2 emissions from LNG combustion at the decomposition plant
    - CO2 emissions from decomposition process
    - HFC-23 leaked from the decomposition plant
  - It is proved that all these can be directly measurable

69 ## Case study: HFC-23 decomposition CDM project: Monitoring

- Emissions outside the project boundary
  - Indirect CO2 emissions by electricity consumption in the decomposition plant (using CO2 coefficient for an average thermal power station)
  - Indirect CO2 emissions by steam input (using a typical LNG boiler energy efficiency)
- It is explained other GHG emissions are negligible
- "It is not considered to estimate the CO2 emissions generated by constructions of the decomposition plant, since it is unrealistic to demand detailed life-cycle-assessment which may suppress CDM scheme."
- Careful justification of the monitoring methodologies are made by clear and detailed explanations for almost all aspects of the project

70 ## DOE accreditation process

- CDM-AT: Desk review, Witnessing, On-site assessment
- CDM-AP: Recommendation to CDM-EB
  - Desk review: paper review
  - Witnessing: check the capacity of validation, verification, certification of CDM project
    - For the witnessing, an actual project and PDD with approved baseline and monitoring methodology are needed
  - On-site assessment: check human resource, management as appropriate
- DOE is necessary for CDM implementation
- Currently, 17 entities are under the assessment of CDM-AP, CDM-AT.
- 2 entities are likely to be accredited at the next CDM-EB

71 ## DOE candidates under assessment (1)

1. Asahi and Co.(Japan)
2. British Standards Institution (UK)
3. BVQI Holdings Ltd. (UK)
4. Chuo Aoyama PwC Research Institute Corporation (Japan)
5. Clouston Environmental (Malaysia)
6. Det Norske Veritas Certification Ltd. (DNV)(Norway)
7. ERM CVS (UK)
8. Japan Audit and Certification Organisation for Environment and Quality (JQCO) (Japan)
9. Japan Consulting Institute (JCI) (Japan)
10. Japan Quality Assurance Organisation (JQA) (Japan)

72 ## DOE candidates under assessment (2)

11. KPMG Certification B.V. (Netherlands)
12. SGS UK Ltd. (Swithland)
13. The Korea Energy Management Corporation (Kemco) (S. Korea)
14. Tohmatsu Evaluation and Certification Organization (TECO)(Japan)
15. TÜV Anlagentechnik GmbH (Germany)
16. TÜV Süddeutschland Bau und Betrieb GmbH (TÜV Süddeutschland)(Germany)
17. URS Corporation Limited (UK)

73 After DOE established...

1. Validation of proposed CDM project
2. If OK, validation report will be submitted to CDM-EB
3. Formal registration of CDM project
4. A DOE can only perform up to this point (validation and registration)
5. After this point, different DOE should take over (for verification and certification)

74 Verification after CDM is implemented (1)

1. After CDM is implemented, project participants shall monitor the project activity based on the monitoring plan in PDD, and submit the monitoring report to DOE
2. Verification of emissions reduction by DOE
    1. Determine the amount of emissions reduction based on the monitoring report
    2. Checking consistency between PDD and what actually occurred
    3. If necessary, on-site assessment
    4. Comparison between actual emissions and baseline
    5. Reviewing monitoring results,monitoring methodology
    6. Verification can be carried out every year? (no specification so far)

75 Verification after CDM is implemented (2)

- DOE: submits the verification report to CDM-EB and open to the public
- DOE: Certifies the amount of emissions reduction (=amount of CERs issued)
- DOE: submits the certification report to CDM-EB and open to the public (=formal request for issuance of CERs)
- CDM-EB: Issuance of CERs in the pending account in the CDM registry

76 Small Scale CDM (SSC-CDM) project

77 Simplifications for SSC-CDM

- More than one SSC projects can be bundled together for PDD, validation, registration, monitoring, verification, certification
    - However, normal CDM cannot be divided into several SSC-CDMs
- Simplified PDD can be used
- One DOE can perform throughout process from validation to verification, certification.
- Lower registration fee and share of proceeds will be applied
- Prompt CDM registration can be made

78 CDM registration fees

- CDM registration fees are as follows depending upon amount of emissions reduction

79

1 # Definitions and Modalities for AR-CDM

Rules decided in COP9

Eisho SATO, Forestry Agency

2 ## Definition of forest for AR-CDM

- Same as definition of forest for LULUCF activities under Article 3:

i.e.

1) minimum area of land of 0.05-1.0ha、
2) minimum crown cover of 10-30%、
3) minimum tree height of 2-5 meters at maturity

3 ## Definition of afforestation for CDM

- Same as definition for afforestation for LULUCF(land use, land-use change and forestry) activities under Article 3:

i.e.

The direct human-induce conversion of land that has not been forested for a period of at least 50 years to forested land.

4 ## Definition of reforestation for CDM

- Same as definition for reforestation for LULUCF activities under Article 3:

i.e.

The direct human-induced conversion of non-forested land to forested land, occurring on those lands that did not contain forest on 31 December 1989.

5 ## Eligible activities for CDM

・The eligibility of LULUCF activities under Article 12 is limited to afforestation and reforestation.

・Therefore, initial plantation in logged after area is not eligible for CDM. (Initial plantation in logged after area is forest management.)

6 ## Project boundary

・It geographically delineates the afforestation or reforestation project activity under the control of the project participants.

・The project activity may contain more than one discrete area of land.

7 ## Baseline net greenhouse gas removals

by sinks

- The sum of the changes in carbon stocks in the carbon pools within the project boundary that would have occurred in the absence of AR-CDM.

- No need minus in emissions.

8 Actual net greenhouse gas removals
by sinks

- The sum of the verifiable changes in carbon stocks in the carbon pools within the project boundary, minus the **increase** in emissions of GHG within the project boundary, attributable to AR-CDM.
- Need minus in emissions.

9 In the case of increased emissions

- e.g. 3 emissions in baseline scenario;
  10 emissions in the project scenario:
- In calculating actual net GHG removals, minus 10-3=7.

(reason: In actual net GHG, it explains "minus the **increase** in emissions".)

10 In the case of decreased emissions

- e.g. 10 emissions in baseline scenario; 4 emissions in the project scenario:
- Emission reductions for 10-4=6, no credits can be attained.

(reason: In actual net GHG, it explains "minus the **increase** in emissions".)

11 Examples of emission reductions in AR-CDM
→No credit can be attained for emission reductions

- There was slash and burn cultivation in baseline scenario. Slash and burn stopped in project scenario. But no credit can be attained for CO2 emission reductions for quitting slash and burn cultivation.
- There was 100 cows and 0 trees in baseline scenario. 30 cows and 1000 trees in project scenario. But no credit can be attained for methane emission reductions for diminishing cow farming.

12 Why can no credit be attained for emission reductions in AR-CDM?

- Because emission reductions is not eligible for LULUCF CDM, but only afforestation/reforestation is eligible.
- Because activity of quitting slash and burn is not afforestation/reforestation but is forest management.
- If we could get credit through emission 12121212reduction in AR-CDM, activities to let the people, who carry out slash and burn, stop and to plant very few trees might create lots of credits.

13 Leakage

- Leakage is the increase in GHG emissions which occurs outside the boundary, which is measurable and attributable to AR-CDM.
- The increase in GHG removals which occurs outside the boundary (positive leakage) is not included.
- The decrease in GHG emissions which occurs outside the boundary is not considered.

14 Net anthropogenic greenhouse gas removals by sinks (This corresponds credits)

Net anthropogenic greenhouse gas removals by sinks
= Actual net greenhouse gas removals by sinks
— Baseline net greenhouse gas removals by sinks
— leakage

15 Carbon pools

Same carbon pools for LULUCF activities under Article 3:
i.e.

- 1)above ground biomass, 2)below ground biomass, 3)litter, 4)dead wood, and 5)soil organic carbon.

16 Choice of 5 carbon pools

- Projects participants may choose not to account for one or more carbon pools in a way that the choice will not increase the expected net anthropogenic removals by sinks comparing the costs of measurements of the carbon pools.

17 Participation requirement for AR-CDM

- Same as participation requirements of energy CDM. i.e. Party to the Kyoto Protocol, Assigned Amount is calculated, national registry is ready, the most recent required inventory is submitted etc.
- In addition to those, non-Annex I country (host country) has selected minimum land area, minimum tree cover, and minimum tree height and reported to the Executive Board through Designated National Authority.

18 When is verification/certification undertaken ?

- The initial verification/certification may be undertaken at a time selected by project participants.
- Thereafter, verification/certification shall be carried out every 5 years until the end of the crediting period.
- A systematic coincidence of verification and peaks of carbon stocks should be avoided.
- It is understood that timing of verification/certification is different from the timing of the peaks for about 1 year.

19 Units of AR-CDM that address non-permanence

- Project participants shall select either Temporary CER (tCER) or Long-term CER (lCER).

- The choice of tCER or lCER shall remain fixed for crediting period including renewals.

20 Crediting period

- Project participants can select either the following:

(a) A maximum of 20 years which may be renewed at most two times. (Renewal means updating.)

(b) A maximum of 30 years. No renewal.

- The crediting period shall begin at the start of AR-CDM.

21 When to use tCERs towards meeting its commitment

- For project participants, meeting their commitments means transferring tCERs from holding a/c to retirement a/c in national registry.
- Annex I Party may use tCERs towards meeting its commitment for the commitment period for which they are issued.
- tCERs may not be carried over to a subsequent commitment period. (Same as RMUs.)

22 Validity of tCER

- Each tCER shall expire at the end of the commitment period subsequent to the commitment period for which it was issued.

23 Issuance of tCERs

- The certification report shall constitute a request to the Executive Board for issuance of tCERs equal to the verified amount of net anthropogenic greenhouse gas removals by sinks since the start of the project.

24 How to replace tCER

- Expired tCER should be replaced by AAU, ERU, CER, RMU, and/or tCER.
- Expired tCER cannot be replaced by lCER.

25 When to use lCERs towards meeting its commitment

- For project participants, meeting their commitments means transferring lCERs from holding a/c to retirement a/c in national registry.
- Annex I Party may use lCERs towards meeting its commitment for the commitment period for which they are issued.
- lCERs may not be carried over to a subsequent commitment period. (Same as RMUs.)

26 Validity of lCER

- Each lCERs shall expire at the end of the last (renewed) crediting period.
- Validity lasts for maximum 60 years.

27 Issuance of lCER (when increased)

- If net anthropogenic GHG removals by sinks have increased since the previous certification report, certification report will request to the

Executive Board for issuance of lCERs equal to the verified amount of net anthropogenic GHG removals by sinks since the previous certification.

28 Issuance of lCER (when decreased)

- If net anthropogenic GHG removals by sinks have decreased since the previous certification report, certification report will notify to the Executive Board of reversal of net anthropogenic GHG removals by sinks since the previous certification.

29 Needs replacement of lCER

when

1) lCERs expire,

2) reversal happens, or

3) certification report has not been provided.

30 How to replace lCER

- Ineligible lCER should be replaced by AAU, ERU, CER, and/or RMU.
- In case of 2) or 3), lCER from the same project activity can replace ineligible lCER.
- Ineligible lCER cannot be replaced by tCER.

31 Difference between tCER and lCER for buyer of the credit.

- Eligibility of tCER is secured until the end of subsequent commitment period even in the case of carbon reversal→The buyer of the credits feels easy to purchase tCERs from all the project participants.
- Eligibility of lCER depend upon existence of carbon reversal and submission of certification report. →Buyer would purchase lCER only from project participants who are reliable.

32 Difference between tCER and lCER for project participants.

- tCER will be replaced at the end of subsequent commitment period. (5 to 10 years after)→It is not so difficult for project participants to outlook the economic situation for purchasing credits for the replacement.
- lCER will be replaced at the end of the last crediting period. (In the longest 60 years after)→ It is very difficult for project participants to outlook the economic situation for purchasing credits for the replacement.

33 Analysis/assessment of socio-economic/environmental impacts (part 1)

- In energy CDM, analysis/assessment of environmental impacts are made.
- In AR-CDM, analysis/assessment of socio-economic and environmental impacts are made.

34 Analysis/assessment of socio-economic/environmental impacts (part 2)

- Project participants submit to DOE documentation of analysis of socio-economic/environmental impacts. If negative impact is considered significant by the project participants or host Party, project participants have undertaken a socio-economic impact assessment and/or environmental impact assessment in accordance with the procedures required by the host party.

35 Analysis/assessment of socio-economic/environmental impacts (part 3)

- Project participants submit Project Design Document that includes analysis of socio-economic/environmental impacts.
- This environmental analysis should include, where applicable, information on, inter alia : hydrology, soils, risk of fire, pests, and diseases.
- This socio-economic analysis should include, where applicable, information on, inter alia : local communities, indigenous peoples, land tenure, local employment, food production, cultural and religious sites, access to fuelwood and other forest products.

36 Additionality (part 1)

- Additionality of AR-CDM and additionality of energy CDM are symmetrical.
- Description of additionality of energy CDM:
  A CDM project activity is additional if anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of registered CDM project activity.

37 Additionality (part 2)

- Description of additionality of AR-CDM:
  An afforestation or reforestation project activity under the CDM is additional if the actual net GHG removals by sinks are increased above the sum of the changes in carbon stocks in the carbon pools within the project boundary that would have occurred in the absence of registered CDM afforestation or reforestation project activity.
- In this provision, interpretation of "in the absence of CDM" is very important. If business-as-usual plantation should occur "in the absence of CDM", baseline scenario and project scenario could be identical and additionality of AR-CDM could not exist at all.

38 Additionality (part 3)

- To avoid "anyway project" or free rider project, some countries wanted to add:
  [... does not result in accreditation of project activities that will have occurred in the absence of the CDM].
- This [ ] part was deleted through negotiation process because of keeping symmetric between AR-CDM and energy CDM.

39 Report of Meth 06→But, it is not EB's report.

- interpretation 1: without the ability to register under the CDM, proposed project activity would be, or would have been, unlikely to occur. A baseline methodology evaluate a priori whether the project activity is the baseline scenario;
- interpretation 2: if the proposed CDM project activity is not implemented, a less GHG friendly activity would have been initiated or be continued instead. A baseline methodology does not evaluate a priori whether the project activity could be the baseline scenario.
- The Meth Panel recommends that the 1st interpretation should be the only one used. (7-8 July 2003)

40 larger emission

41 Report of EB10: tool to demonstrate additionality

- Examples of tools may be used to demonstrate that a project activity is additional and therefore not the baseline scenario include, among others:

(a) A flow chart or series of questions that lead to narrowing of potential baseline options; and/or

(b) A qualitative or quantitative assessment of different potential options and an indication of why the non-project option is most likely; and/or

(c) A qualitative or quantitative assessment of one or more barriers facing the proposed project activity (such as those laid out for small-scale CDM projects); and/or

(d) An indication that the project type is not common practice (e.g. occurs in less than [< x%] of similar cases)

,and not required by a Party's legislation/regulations.

(28-29 July 2003)

42 Baseline methodology

Project participants shall select from among the following approaches the one deemed most appropriate:

(a) Existing or historical changes in carbon stocks;

(b) Changes in carbon stocks from the land use that represents an economically attractive course of action, taking into account barriers to investment;

(c) Changes in carbon stocks from the most likely land use at the time the project start.

((a) and (b) are symmetric to those of energy CDM.)

43 Small Scale AR-CDM

- Threshold of Small-scale energy CDM: 15 k CO_2-t/yr
- Small-scale AR-CDM:

- Net anthropogenic removals by sinks is less than 8 k CO_2-t/yr, and
- developed or implemented by low-income communities and individuals as determined by the host Party.

- 8 k CO_2-t/yr corresponds to 300 ha of *Eucalyptus* or 1000 ha of indigenous species in dry forests.
- COP requests SBSTA to recommend a draft decision on simplified modalities and procedures for small-scale AR-CDM, taking into account Parties' submissions due on 28 February 2004 and the technical paper prepared by the Secretariat, for adoption by COP 10.

44 invasive alien species

GMO(genetically modified organisms)

- Draft decision of COP 9 says: COP recognizes that host Parties evaluate, in accordance with their national laws, risks associated with the use of invasive alien species/GMO by AR-CDM and that Annex I Parties evaluate, in accordance with their national laws, the use of tCERs/lCERs generated from AR-CDM.
- There is no provision concerning invasive alien species or GMO in the ANNEX, which explains modalities and procedures.
- Invasive alien species are explained in

http://www.iucn.jp/protection/species/worst100.html

45 International agreement

- Draft decision of COP 9 says: COP is cognizant of relevant provisions of international agreements that may apply to AR-CDM.
- No specific names of conventions such as CBD, CCD, or Cartagena Protocol.
- There is no provision concerning an international agreement in the ANNEX, which explains modalities and procedures.

1 **Project Cycle in Sink CDM**

2 **Overview of the Project Cycle**

◈Project Cycle

3 **Closer look at each component**

Project Design (PP)

◈Identification of project site

- In a country where socioeconomic conditions are stable
- Land tenure/title is clear
- Land which has not been forested since 1990

◈Identification of local counter part

- Reliable local counter part is crucial (knowledge on local regulations, customs, etc)

4 **PDD and New Methodology/ Approved Methodology**

5 **Entity involved in approval of New Methodologies**

6 Procedure for approving proposed new methodologies

7 **Mechanism of how CDM EB works for approving NM**

◈Project participants willing to validate / register a CDM project activity shall:

–use an approved methodology by the EB

–propose a new methodology to the EB for consideration and approval

8 **Mechanism of how CDM EB works for approving NM**

◈**Submit proposed NM:**

- The project participant proposes a NM, through a DOE
- The DOE determines whether the proposed project activity intends to use a NM.
- The DOE shall check and forward the proposed NM to the EB for review

9 **Mechanism of how CDM EB works for approving NM**

◈**Submit proposed NM:**

- The secretariat forward the documentation to the EB and to the Meth Panel (MP) after having checked by DOE
- Preliminary communication with MP and project participants

- The secretariat makes the proposed NM publicly available on the CDM web site for public comments

10 Mechanism of how CDM EB works for approving NM

- Desk Reviewers (DR) will review and comment on the NM
- MP will based on DR comments, further review NM and recommend it to EB
- EB will decide on the grading of the NM and once approved, EB will make it publicly available → Approved Meth

11 Validation 1 (DOE)

- After approval of NM submitted to EB, DOE can proceed with validation process
  - DOE checks requirements and conditions such as:
    - ***Participation requirements***
    - ***Stakeholder comments***
    - ***Socio-economic and environmental impacts***

12 Validation 2 (DOE)

- DOE checks requirements and conditions such as (cont):
  - ***Additionality requirements***
  - ***Baseline scenario***
  - ***Monitoring plan***
  - ***Leakage*, etc**
- Details will be discussed in the section of PDD and technical discussion

13 Validation 3 (DOE)

- Once the project is validated, DOE submits a *validation report* to EB
  - DOE also informs project participants the date of submission (confirmation of validation as well)
  - DOE requests EB to register the project
  - DOE makes the report publicly available

14 Registration (EB)

- Upon receipt of validation report and the request by the DOE, EB will register the project as a CDM project unless a request by following entity is made:
  - A Party involved in the proposed project;
  - At least three members of the Executive Board

15 Monitoring 1 (Project participant)

◆After registration of the project, the actual CDM project activity starts with monitoring activity, and monitoring involves:

- ***Actual net GHG removals***
- ***Baseline net GHG removals***
- ***Techniques for sampling and measuring carbon pools and GHG emissions by sources***

16 ## Monitoring 2 (Project participant)

◆Monitoring involves (cont):

- ***All potential sources of leakage***
- ***Provides a monitoring report for the purpose of verification and certification,*** etc

17 ## Verification/Certification 1 (DOE)

◆After project implementation and monitoring, independent review by DOE is conducted (verification)

◆Certification is assurance of the net GHG removal by the project activity and given after verification

18 ## Verification/Certification 2 (DOE)

◆Verification involves:

- On-site inspection on a *review of performance records*
- interviews with PP and stakeholders
- *collection of measurements*, testing of the accuracy of monitoring equipment
- *socio-economic and environmental impacts,* etc

19 ## Issuance of CER (EB)

◆DOE finalize certification report and make request to EB to issue CERs and the report specify whether PP has chosen:

- tCERs (temporary CER)
- lCERs (long-term CER)

1 **Project Design Document (PDD) of Sink CDM**

2 **What is PDD?**

- ◆PDD is a project proposal which explains how the project activity removes GHG
- ◆Used as a basis for validation
- ◆Contains information regarding requirements of CDM project
- ◆Written with application of the approved methodology of both Baseline and Monitoring

3 **Possible contents of PDD in the Sink CDM** (Appendix B of L.27)

(a) A description of the project activity
(b) A description of the present environmental conditions of the area
(c) A description of legal land title, rights of access to the carbon, current land tenure and land use
(d) Carbon pools selected
(e) BL methodology in accordance with the present annex
(f) Measures to minimize potential leakage
(g) Start date for the project activity and the choice of crediting periods
(h) Selected approach for non-permanence

4 **Possible contents of PDD in the Sink CDM** (Appendix B of L.27)

(i) Description of how the net GHG removals by sinks are increased
(j) Environmental impacts of the project activity
(k) Socio-economic impacts of the project activity
(l) A description of planned monitoring
(m) Information on public funding from Annex I Parties
(n) Stakeholder comments
(o) A monitoring plan that meets the requirements of para 25
(p) Calculations

5 **Sections of PDD** 1 (a) – (c)

◆Sections (a) – (c) mainly require basic information of the proposed project activity

- Purpose of the project activity, Technical description, location and boundaries
- Climate, hydrology, soils, ecosystems etc
- Legal title to the land, rights of access to the sequestered carbon

6 **Sections of PDD** 2 (d)

◆In section **(d)**, specify carbon pools to include or exclude. There are 5 carbon pools:

- above-ground biomass,
- below-ground biomass,
- litter,
- dead wood and
- soil organic carbon

7 **Sections of PDD** 3 (e) - ①

◆BL methodology: Generic method of how to prove additionality and set baseline (for the procedure see project cycle)

- Not project specific
- Qualitative or quantitative criteria of proving additionality
- Method of how to set baseline

8 **Sections of PDD** 3 (e) - ②

◆Some examples:

- Reforestation project in Surabaya, Indonesia → in host country or SE Asia
- Additionality test:
  - No law enforcement to plant (not common practice)
  - Low IRR, ROE (financial barrier), etc
- Method of how to set baseline
  - Criteria to take into consideration
  - Possible scenario options (decision trees , scenario analysis etc)

9 **Sections of PDD** 4 (f) ①

◆In section (f), you need to describe measures to minimize leakage

- E.g. Agricultural land → Plant trees → Agroforestry
  - During the initial phase, crop production decreases → may cause cut down of more area for crop production
- Note:
  - Count only negative leakage
  - Only leakage by sources

10 **Sections of PDD** 4 (f) ②

11 **Sections of PDD** 5 (g) - (h)

◆For section (g), specify starting date and the crediting period you chose

- Crediting Period = 30 yr.*1 or 20 yr*3

◆In section (h) , choose an approach for addressing non-permanence issue

- Specify whether to chose tCER or ICER

12 **Sections of PDD** 6 (i)

◆Section (i) requires a brief explanation of how the project increases GHG removal ADDITIONALLY

- It is a section for brief description of additionality
- List up barriers, examples of why the project activity is not common practice

13 **Sections of PDD** 7 (j) – (k)

◆If any negative impact is considered significant by the project participants or the host Party, project participants need to conduct socio-economic impact assessment and/or an environmental impact assessment in accordance with the procedures required by the host Party

- When developing a project, you need to know what criteria are applied to what type of project (e.g. EIA is needed for any plantation exceeding 1,000 ha)

14 **Sections of PDD** 8 (l) – (n)

- Section (l) covers monitoring to address negative impacts regarding socioeconomic/ environmental aspects.
- (m) → whether ODA is included or not
- In section (h), stakeholder comments are dealt with. A summary of the comments, and a report on how due account was taken of any comments received.
  → local participation is necessary

15 **Sections of PDD** 9 (o)

- Section (o) covers monitoring.
  - Apply an AM for monitoring methodology
  - On technical issue of monitoring, the detailed discussion can be found in Good Practice Guidance for Land Use, Land-Use Change and Forestry (Chapter 4.3)
    - Stratified sampling, sampling effort vs uncertainty, pool and gas coverage, etc

16 **Sections of PDD** 10 (p)

- In the section (p), you need to calculate GHG removals
  - formulae used to estimate the baseline net greenhouse gas removals by sinks
  - formulae used to estimate leakage
  - formulae used to calculate the actual net greenhouse gas removals by sinks
  - formulae used to calculate the net anthropogenic greenhouse gas removals by sinks

1 ## Interests of Project Participants in Sink CDM

2 ## Interests of Project Participants 1

- Advantages and Disadvantages of applying tCER and lCER in industrial plantation, Agroforestry and Environmental Reforestation?
- How do you prove additionality as it is done in Energy sector CDM?
- How do you decide BL scenario (How do you list up what options and how do you narrow down to 1 scenario)?

3 ## Interests of Project Participants 2

- How do you minimize and deal with leakage ?
- What are the advantages and disadvantages regarding the choice of Crediting Period?
- How do you cope with invasive exotic species and GMO?
- What are the perspectives on SSC and issues related to it?

4 ## Interests of Project Participants 3

- Regarding socioeconomic/environmental impacts, how and what do you analyze?
- What is a concrete monitoring method?
- What are the issues related to validation and verification?

5 ## Technical Aspects of Sink CDM

6 ## What are the key issues regarding technical aspects

- ***Additonality***
- ***Baseline setting***
- ***Monitoring Plan***
- ***tCERs and lCERs***
- ***Leakage, Socio-economic/ Environmental Impacts***
- Others (base year, forest definition, etc)

7 ## Basic requirements for CDM projects

- Additionality
  - Project $\neq$ Baseline scenario →Additionality
- Baseline scenario
  - Justifiable and reasonable
- Monitoring Plan
  - Good monitoring to ensure GHG removals by sinks

8 **Additionality 1**

◈COP9 Decision: For the definition, please refer to Mr. Sato's presentation.

9 **Additionality 2**

◈Examples:

- Absence of legal obligation of reforestation
- Economical & financial barriers (low IRR, large initial capital investment, etc)
- Planting trees is not common practice etc

10 **Additionality 3 (in sink CDM)**

◈Barriers:

- Land tenure
- Political risks
- Other risks: Fire/Insects/Diseases/Human factor
- Financial/Economical: Low IRR/NPV,
- Technological aspects: High mortality rate, soil conditions   Introducing mycorrhiza etc

◈Not common practices

11 **Additionality 4 (Ways to prove in Energy sector)**

(a) A flow-chart narrowing of potential baseline options; and/or

(b) A qualitative or quantitative assessment of different potential options and an indication of why the non-project option is more likely; and/or

(c) A qualitative or quantitative assessment of one or more barriers; and/or

(d) An indication that the project type is not common practice (e.g. occurs in less than [<x%] of similar cases) in the proposed area of implementation, and not required by a Party's legislation/regulations.

12 **Baseline 1**

◈COP9 decision: (see Mr. Sato's ppt)

◈BL is a reference compared with real project removals

◈BL serves to quantify removals of CO2 that are additional as a result of the project activities

13 **Baseline 2**

◈Concept of BL

14 **Baseline 3**

◈3 Approaches: Choosing a BL methodology (choose only 1)

- Existing or historical changes in carbon stock
- Changes in carbon stocks in the project boundary from a economically attractive land use
- Changes in carbon stocks in the project boundary from the most likely land use at the time the project starts

15 **Baseline 4**

◈Typical BL setting

- List possible scenarios
- By decision trees, qualitative/quantitative assessment, scenario analysis, etc, choose most probable option as a project BL
  - (In this process, you would have to prove your project activity is not the BL scenario)

- Quantify BL removal

16 **Baseline 5**

17 **Baseline 6**

18 **Monitoring 1**
(Project participant)

- Monitoring refers to collection and archiving of all data for determining the baseline, measuring removal by sinks of GHG in the project boundary involves :
- Data for estimating the *actual net GHG removals* by sinks during the crediting period
- Data for determining the *baseline net GHG removals* during the crediting period

19 **Monitoring 2**
(Project participant)

- If the project uses control plots for determining the baseline, specific techniques for sampling and measuring *carbon pools* and *GHG emissions by sources*
- Identification of all potential *sources* of leakage during the crediting period
- Project participant provides a *monitoring report* for the purpose of verification and certification

20 **Monitoring 3**
(Project participant)

- Industrial Plantation
  - More data available in terms of biomass, expansion factor
  - Tree forms/shapes could be more uniform
- Agro-/Social Forestry
  - Higher variability, scattered in many areas, different species, etc
  - Local involvement necessary etc
- Environmental Plantation
  - Even higher variability than agroforestry

資料２．国内研修 海外参加者からの説明資料集

POTENTIAL AND CONSTRAINTS FOR AR-CDM IMPLEMENTATION IN INDONESIA

INTRODUCTION

Clean Development Mechanism is one of mechanism offered by Kyoto Protocol to achieve sustainable development of forest management in developing countries as well as reducing Green House Gas (GHG) emission of developed countries, which could be done by implementing Afforestation and Reforestation (AR). Indonesia commitment on climate change is ratified in Law No. 6/1994, confirming Indonesia commitment to United Nation Framework Convention on Climate Change, UNFCCC.

Considering the large forest area, third after Brazil and Zaire, Indonesia potential as one of the sink country is not questionable. This paper aims to explore the potential and constraints for AR-CDM deployment in Indonesia, and develops strategies needed to facilitate the implementation.

LAND USE IN INDONESIA

Land use issues are important in Indonesia. Table 1 summarises current land use in Indonesia. The total area of Indonesia is about 780 millions ha, consisted of land area of about 191,277,938 ha, and about 56.7 % of this land (108,571,713 ha) are forests[1] (Table 1), which form about 45 % of the tropical forest in Southeast Asia. Table 1 show the potential of land use for the global carbon market.

Table 1. Land use in Indonesia, 2000

	Land use	Area (Ha)	% of total
1.	Forest cover *)	108,571,713	56.7 %
2.	Wood land / agroforestry	8,905,200	4.7 %
3.	Agriculture / paddy field	8,106,356	4.2 %
4.	Plantation	16,543,663	8.6 %
5.	Fallow land	10,260,492	5.4 %
6.	Grassland	2,424,469	1.3 %
7.	Shifting cultivation / waste land / garden	12,768,711	6.7 %
8.	House compound and surroundings	5,131,727	2.7 %
9.	Dyke / ponds	642,905	0.3 %
10.	Mosaic of mixed vegetation cover & others	17,922,705	9.4 %
	Total land area *)	191,277,938	100 %

Sources: Bureau of Indonesian Statistic (BPS, 2001), *MoF. (2001)

[1] Forest as defined by the Indonesian is an area dominated by a group of trees having height usually more than 5 meters, with forest canopy cover bigger than 40 %, and having at least 2 canopy layers, rich in biodiversity, perform specific micro climate, and dense group forest layer.

AR-CDM should be directed to maintaining forest area from deforestation including illegal logging, forest fires, as well as improving welfare of people in the forest frontier.

To support AR-CDM implementation, several studies on potential carbon stocks from several AR-related activities such as agroforestry, monoculture forest plantation, afforestation, enhanced natural regeneration, and reduced impact logging have been undertaken (ICRAF, 1988, Murdiyarso, et.al., 2000, Boer, et.al., 2001, Ginoga, et.al., 2002). These studies used several methods and model on measuring carbon, depend on the whole purposes of the study. The most frequent and easiest methods were alometric equations for above ground biomass, using several models including Brown (1997).

Indonesia National Strategies Studies on LULUCF CDM (2003) reports that potential carbon stock of Indonesia around 24,704 Mt Carbon. Of which, 79% are coming from forest, plantations (11%) and woodland / agroforestry (4.5%). How to change the potential to reality is a challenge for Indonesia Government and others stakeholders involved in CDM implementation. Steps for doing this could be done through understanding constraints and steps needed for implementation.

CONSTRAINTS FOR CDM DEPLOYMENT

In general, potential constraints for CDM implementation in Indonesia can be grouped into: (i) technical constraints, (ii) socio-economic constraints, and (iii) institutional constraints (Table 2). Technical constraint includes designing a good AR-CDM project which needs careful consideration on: clear and justifiable criteria for sustainable development, the opportunity costs of landholders of changing to a new land use, and risks.

Socio-economic considerations are also another important constraint, mainly because of high population density with high level of poverty. About 17 per cent of 215 million Indonesia populations is categorised as below poverty line (Republika, 2003)). Therefore AR CDM project which financially viable and equitable is needed as an incentives for people in the forest frontier to maintain project, This issues need to be handle properly, before implemented CDM.

Institutional constraints faces would be clear guidelines and regulation for getting Certified Emission Reductions (CERs). Stakeholders need to have clear understanding on how long, how simple, and how much cost needed to established CDM projects. Lesson learnt from pre AR-CDM project in Indonesia need to be socialised, to understand potential costs and benefit gained from potential CDM project. Land tenure and land security are needed to avoid conflict.

Table 2. Constraints for Deployment of CDM in Indonesia

No.	Technical	Sosio-Economic	Institutions
1	Project design	Project viability	Guidelines and Regulation
2	Technical instruction	Financing (Internal and External	Government commitment
3	Land security	Credit access	Community support
4	Silviculture technology	Investation	Land tenure
5	Technology transfer	Profit	Permit issuance
6	Baseline, additionally, and monitoring	Tax	Expert availability
7	Land availability	Land competition	
8	Land productivity	Fallow period	
9	Planting material availability		
10	Accessibility		
11	Growth and Yield		
12	Labour		
13	Leakage (theft, fire,& insects)		

STEPS FOR CDM IMPLEMENTATION

Indonesia is behind Malaysia, Vietnam, Thailand, Philippine and other neighboured countries in preparation for CDM implementation. Two prerequisite for implementing CDM i.e., Kyoto Protocol ratification and establishing Designated National Authority (DNA) has yet to finished.

Based on Autonomy law No. 22/1999, location of CDM projects would be in district or provincial level. Therefore strengthening district and provincial knowledge of CDM as well as indicating relevant institution and their role in CDM is needed. Table 3 shows step for getting CERs in CDM.

Table 3. Steps to get CERs

No.	Steps	Roles
1.	Identification of project	Project developer
2.	GHG benefit and Design Project: a. Set project: baseline, boundaries, additionality b. Calculate baseline and project emissions c. Adjust for leakage and risk	Project developer
3.	Approval Validation of project	National authority Operational entities (OEs), Annex 1 country
4.	Registration	Executive board
5.	Implementation of contracts	Project managers, NGOs, landholders
6.	Monitoring	Project developer
7	Enforcement	Project developers, Oes
8.	Insurance	Oes
9.	Verification	Oes
10.	Certification and Sale of CERs	Oes

Source: modified from Aukland, et.al., 2002,

Steps for CDM deployment in Indonesia are as follows:

(i) enhancing understanding of CDM potentials and constraints for stakeholders in district and provincial level,
(ii) establishing institutions supporting CDM implementation,
(iii) creating provincial and district law and regulation about CDM, and
(iv) Establishing CDM forestry's pilot project in district level, as an example of real CDM forestry project, using criteria and standard guided by international, national, provincial, and district procedures.

CONCLUSIONS

While acknowledging that potential of Indonesia AR-CDM project is huge, preparation for CDM deployment is limited and behind schedule. Understanding of stakeholders about CDM is also relatively limited. Therefore strong and clear institutions, avoid socio-economic risk, and simple procedures for CDM implementation are needed. Implementation of CDM should also support the strategy for critical land rehabilitation and logged over area, as well as should be secure from political, technical, and legal aspects.

Several steps need to undertake immediately as follows: (i) enhancing understanding of CDM potentials and constraints for stakeholders in district level, (ii) establishing institutions supporting CDM implementation, (iii) creating provincial and district law and regulation about CDM, and (iii) establishing AR-CDM pilot project.

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BRIEFLY OF THE NATIONAL FORESTRY POLICY IN VIET NAM

Mr. Bui Chinh Nghia

Deputy chief of Forestry Basic Inventory Division

Forestry Department

1

Summary

- Total of land is approximately 33,000,000 ha
- 19,134,671 ha classified is forestry land and Its including
  - Nature forest 9,865,020 ha include

2

Summary (continue)

- Protection forest: 4,905,027 ha
- Special use forest: 1,654,131 ha
- Production forest: 3,305,862 ha

- Plantation forest 1,919,569 ha, include
  - Protection forest: 709,277 ha
  - Special use forest: 73,248 ha
  - Production forest: 1,137,048 ha

3

Summary (continued)

- The land not cover by forest: 7,350,082 ha
- The forest cover is 35,8% of total land in 2002
- forest cover estimation of the year 2003 is 37%.

4

National Five Million hectare Reforestation Programme (1998-2010)

- Objectives:
  - Protection of existing forest; Created 5 million ha new forest
  - Use open land and bare hills efficiently ...
  - Provide material for construction as well as raw material; Develop the forest processing industry ...

5

Five Million ha (Continue)

- The result of the period 1998-2003:
  - Forest plantation: 1,713,233 ha, include
    - Special-use and protection forest: 1,196,594 ha
    - Production forest: 516,629 ha
  - Forest protection:2,432,960 ha

6

Studied on Green House Gas emission in forestry sector

- The biggest Emission of CO2 is due to change the land-used purpose
- The biggest Absorb of CO2 is due to increase the volume of existing forest
- The balance of CO2 in Forestry and Land-use purpose changing is emission of 19.39 Mil Tons CO2 approximate 18.4% of total CO2 emission of country in 1994.

7

Statistic of GHG in forestry sector and land-use purpose changing

Type of emission/absorb	Emission(+)absorb(-) /million tons a year
1. Absorb CO2 from increase volumes the existing forest	-39.27
2. Absorb CO2 from regeneration of new forest	-11.05

8

Statistic of GHG in forestry sector and land-use purpose changing

Type of emission/absorb	Emission(+)absorb(-) /million tons a year
3. Emission of CO2 from land use purpose changing	+ 56.72
4. Emission of CO2 from terrestrial	+ 8.83

9

Statistic of GHG in forestry sector and land-use purpose changing

Type of emission/absorb	Emission(+)absorb(-) /million tons a year
5. CH4, NO2, NO emission (transferred to CO2)	+ 4.16
Emission Balance (Actual Emission)	+19.39

10

Prediction of CO2 emission in Forestry and land-use purpose changing

Emission of Based year 1994	+ 19.4 Million Tons CO2
Emission in 2000	+ 4.2 Million Tons CO2
Emission in 2004	Balance
Emission in 2010	- 21.7 Million tons CO2
Emission in 2020	- 28.4 Million tons CO2

11

Forestry Policy with view point of CDM

- Established the AR-CDM activities group, head by General Director of Forestry Department.
- On-going to identified the Indicator and Criteria for AR-CDM in Viet Nam, base on the guideline of IIED and Viet Nam conditions

12

Forestry Policy with view point of CDM (Continue)

- To establish the capacity building for staff through forestry extension section to disseminate the concept of AR-CDM to grassroots
- Finding and identify the suitable areas for the formulate of CDM projects with the beneficiaries is focus on farmer

13

Forestry Policy with view point of CDM (Continue)

- Admit the organizations as Research Institutes, University to joints and cooperate in AR-CDM activities

14

- thanks you for your attention

15

Forest policy with a view point of A/R CDM
The Myanmar Experience

1. Introduction

The environment condition in Myanmar is not yet severe, but the consequences of climate change have become noticeable recently. The Clean Development Mechanism is, therefore, visualized as an important mechanism to assist developing countries like Myanmar to attain sustainable development goals as to contribute to the ultimate objective of the convention. CDM offers many opportunities, both in terms of attracting developed countries to invest in greenhouse reduction projects in the country and, concurrently, blaze a way towards sustainable development.

Myanmar has a wealth of natural forest resources which, apart from sustainably satisfying the needs for forest products, will continue their protective functions to ensure ecological and climatical stability, biodiversity richness, soil and water conservation and services to facilitate health and recreation. Though the Myanmar Forest Policy stipulates that plantation forestry is only supplementary to natural forest management, large-scale plantations are being established to replenish deforested areas and also to create additional future forest resources of different uses and services.

This paper describes conservation of natural forest and, particularly, afforestation and reforestation activities which may contribute towards CDM objectives in the country.

2. Policy and Legislation

2.1 Myanmar Forest Policy

To formalise the commitment and intent of the Government to ensure the national goal of sustainable forest management and development, and for optimization of socioeconomic benefits, ecosystem integrity, climate and environmental stability, the Myanmar Forest Policy, 1995 has been adopted with its six imperatives, namely,

(i) Protection of forests, biodiversity and the entire environment

(ii) Sustainability of forest resources

(iii) Satisfying the basic needs for forest products and services

(iv) Efficiency to fully utilize the potential of the forest resources

(v) People's participation in forestry, and

(vi) Public awareness of the role of forests in the well being and socioeconomic development of the nation

2.2 Forest Legislation

The new forest Law, formulated in a holistic manner and enacted in 1992, highlights forest reservation and protection, management of forest lands, establishment of forest plantations environmentally friendly extraction of forest produce efficient, downstream processing in wood-based industry and strict procedures against forest offinces while it encourages people participation in forestry and involvement of private sector in the general development of the forestry sector.

3. Forest Resources

3.1 Status of Land Use

In Myanmar, economic development is based on agriculture with great emphasis placed on sustainable development in this sector. Net sown area of agriculture has, therefore, increased sharply during 1996 – 2002 as a result of the national land reclamation programme and development of irrigation facilities. However, agricultural expansion has taken place mostly in non-forested areas and forest land use largely remains stable. The status of landuse in 2002 is given in Table 1.

Table 1: Status of Land Use in Myanmar (2002)

No.	Land Use	Area (Km^2)	% of Land area
1	Permanent Forest, Estate	173,739	25.68
2	Unclassified Forests	180,008	26.61
3	Net Sown Area	157,831	23.33
4	Fallow Land	8,972	1.33
5	Cultivable wasteland	74,759	11.05
6	Other Lands	81,268	12.01
	Total	**676,577**	**100.00**

3.2 Forest Cover

The forest resource assessment (FRA 2000), conducted by FAO in collaboration with Forest Department (FD) of Myanmar, indicates that Myanmar is still endowed with a forest cover which constitutes 52% of the total area of the country, one of the highest in the Asia-Pacific Region. Closed and open forests respectively account for 37.4% and 14.9% of the total land area as indicated in Table 2.

Table 2: Forest Cover (2002)

Category	Area (Km^2)	% of Land area
Closed Forests	252,939	37.38
Open Forests	100,808	14.90
Total Natural Forests	353,747	52.28
Shrubs	107,232	15.85
Forest Fallows	11,961	1.77
Total open woodland	119,193	17.62
Other Lands	203,637	30.10
Total	676,577	100.00

Changes in forest cover are shown in Table 3 which indicates forests cover at different periods.

Table 3: Forest Cover Changes

Year of appraisal	Forest Cover (Km^2)	% of total land
1925	445,187	65.8%
1955 (1st appraisal)	387,003	57.2%
1975 (2nd appraisal)	356,656	52.7%
1989 (3rd appraisal)	343,701	50.8%
1997 (4th appraisal)	353,747	52.3%

3.3 Permanent Forest Estate (PFE)

The status of PFE in 2002 is indicated in Table 4. In Myanmar, PFE comprises Reserved Forests (RF), Protected Public Forests (PPF) and Protected areas System.

Table 4: Status of PFE in Myanmar (2002)

Category	Area (Km^2)	Percent of Land area
Permanent Forest Estate	173,739	25.68%
- Reserved Forests	114,995	17.00%
- Protected Public Forests	26,799	3.96%
- Protected Areas System	31,945	4.72%
Unclassified Forest Area	180,008	26.60%
Total Forest Cover	353,747	52.28%

Source: Forestry in Myanmar (2003)

3.4 Types of Forest Vegetation and Productivity

Due to its wide latitudinal and topographic coverage Myanmar possesses a vast variety of vegetative types ranging from mangroves in the coastal areas, through broad-leaved species to conifers in the northern parts of high elevation. The forest vegetation types and productivity are indicated in Table 5.

Table 5: Forest Types by Vegetation and Productivity

Km^2

Types of Vegetation	Productive forests	Unproductive forests	Total
Broad-leaved	206,550	119,080	325,630
Mangrove	3,820	4,030	7,850
Bamboo	9,630	–	9,630
Conifers	10,640	–	10,640
Total	230,640	123,110	353,750

Source: Planning and Statistics Division, Forest Department

4. Sustainable forest management

4.1 Management System

In Myanmar, although systematic forest management dates back to the monarchial days, it has been officially recorded that scientific management started in 1856 with the introduction of a system which has gradually evolved to what is now known as the Myanmar Selection System (MSS). It is basically a selection-cum-improvement system under which mature and over mature trees are extracted while the remaining stock is carefully protected and assisted to attain a healthy maturity.

Under the MSS forests are formed into felling series (FS) each of which is divided into 30 annual coupes of approximately equal productivity. One coupe is visited a year in succession and the whole FS is worked over in a cycle of 30 years. In each visit mature and overmature trees are selected for harvest. Exploitable limits are carefully determined and fixed at sizes beyond which trees are not expected to put on appreciable increment and their retention would only interfere with the growth of young trees and impede new regeneration. Cultural operations are provided once during the selection period and again in mid-cycle.

4.2 Silvicultural treatments

Apart from the extraction of mature trees, which itself can be considered as a cultural operation, various kinds of silvicultural treatments are provided in various degrees and extent for a range of conditions.

(i) Improvement fellings (IF)

(ii) Climber cutting and "Nyaungbat" felling

(iii) Gap and enrichment planting

Gaps created in the natural forests are planted up with suitable species and valuable species introduced in locations where density and composition of important species are low with a view to enrich existing forests and prevent genetical inbreed depressions. This also improves the density of the forests and contributes towards carbon sequestration and reduction in GHGs emissions.

4.3 Forest Protection

The Forest Department, within the updated legal framework regulates annual harvesting on a sustainable basis and in an environmentally friendly manner. It also effectuates protection against illegal felling and encroachments, usually with peoples' participation, and by law enforcement where necessary.

Forest fire protection, prevention and suppression measures are taken under the provisions of the Forest Law to prevent serious fires. However, most fires in Myanmar are light surface fires which are considered to be more helpful than harmful especially to the fire-hardy valuable species.

Insect and disease outbreaks are very rare and Myanmar has never experienced serious damages. Isolated insect attacks had been reported, but they are confined to plantations, limited and localized in nature.

5. Afforestation/ Reforestation

5.1 The Forest Law, 1992 has provisions for the establishment of the following plantation on forest land or land at the disposal of the Government.

(a) commercial plantation;
(b) industrial plantation;
(c) environmental conservation plantation;
(d) local supply plantation;
(e) village firewood plantation;
(f) other plantation.

5.2 In Myanmar reforestation was initiated as early as 1856 when small-scale teak plantations were established by the world renowned "*taungya*" method. In earlier times, silvicultural treatments were provided up to the age of 40 years after which planted areas were left to merge with the natural surroundings.

Reforestation gained momentum in early 1960's with the main objectives to rehabilitate degraded forests, restore defoersted areas and supplement production from the natural forests. Large-scale plantation forestry started in the 1980's and about 30,000 ha of forest plantations have annually been established since. However, as asserted in the Myanmar Forest Policy, 1995, plantation forestry has always been supplementary to natural forest management and will not replace it.

The major types of plantation established by FD are Commercial, Village Supply, Industrial and Watershed Plantations.

The Dry Zone Greening Department (DZGD), instituted in 1997 with the special tasks to restore environment, prevent desertification and mitigate climate change has an annual planting quota of 25,000 ha.

Several NGO's, of which JIFPRO is a prominent one, contribute to the environment restoration programme in the Dry Zone through assistance in the establishment of forest plantations.

A total of 767,497 ha have been planted up country wide as shown by the types of plantation in Table 6.

Table 6: Forest Plantations by type (2002)

Sr. No.	Plantation type	Area (ha)	Percent of total area
1.	Commercial	418,550	55%
2.	Industrial	59,614	8%
3.	Village Supply	201,377	26%
4.	Watershed	87,776	11%
	Total	**767,497**	**100%**

Source: Planning and Statistics Division, FD

5.3 Voluntary tree planting

In Myanmar, tree planting is considered to be a meritorious deed by tradition and religion. FD distributes more than 17 million seedlings annually to the public including school children for planting in school compounds, homesteads, farms, backyards, on roadsides and along the banks of canals and streams, etc.

6. Contribution to CDM

The forestry activities, apart from the obligation to achieve sustainable development in the management of forest resources, contribute towards attaining CDM requirements. The afforestation and reforestation programmes not only serve commercial and greening purposes but, being additional to the existing forest carbon, also help reduce GHGs omission and mitigate global warming.

6.1 CDM Activities in the Forestry Sector of Myanmar

Myanmar, in recognition of the importance of global support to reduce GHG emissions, ratified the United Nations Framework Convention on Climate Change (UNFCCC) in November, 1994, which entered into force on 23 February, 1995. It joined the Asia Least Cost Greenhouse Gas abatement Strategy (ALGAS) regional project in 1995. On 12 August, 2003, the Myanmar Government signed the Kyoto protocol.

7. Status of Carbon Emission and uptake

After joining ALGAS, Myanmar launched the national ALGAS project in 1996 with the principal objective to reduce the rate of growth in GHGs emission and also to enhance the development of the carbon sinks. Under the project GHG inventories were conducted for all related sectors in the country to estimate the status and magnitude of emission and uptake of GHGs with the base year 1990 as reference.

The Intergovenmental Panel on Climates Change (IPCC) methodology was applied for the aforesaid inventory. The results of the national GHGs inventory for the Land Use Change and Forestry Sector are herewith presented.

7.1 Total CO_2 emission and uptake

The analysis of the results of the GHGs inventory had indicated that the net CO_2 emissions from the forestry sector in 1990 was –2362 kt of C.

Detailed information is provided in Table 7.

Table 7: Forestry and land use change sector, total CO_2 emissions and uptake

Sr. No.	Particulars	Net emission/ uptake (kt of C)
1	C uptake from changes in forest and other woody biomass stocks	- 12,736
2	C emission from forest and grassland conversion	+17,342
3	C uptake in abandonment of managed lands	- 7,171
4	Non-CO_2 gas emission (trace gases) in terms of CO_2 equivalence	+ 204
	Net CO_2 emissions from forestry sector	- 2,362

+ = Emission, - = Uptake

7.2 Baseline Scenario Projection of Sector GHGs Inventory to 2020

The National ALGAS Project also projected CO_2 emission and uptake up to year 2020, assuming that total area of actual forests in the country was 34.4 million hectares in 1990 with the annual deforestation rate of 0.2 million hectares. CO_2 data projection from 1990 to 2020 is shown in Table 8.

Table 8: Project of C emission/uptake from 1990 to 2020, forestry sector

No.	Particulars	1990 ktC	2000 ktC	2010 ktC	2020 ktC
1	C uptake from changes in forest and other woody biomass stocks	-12,736	- 12,480	-12,077	-11,674
2	C emission from forest and grassland conversion	# +17,342	# +17,342	# +17,342	# +17,342
3	C uptake in abandonment of managed lands	- 7,170	- 7,115	-7,086	-7,068
4	non-CO_2 traces gases in terms of C	+ 204	+ 204	+ 204	+ 204
5	Total net C uptake	-2,362	-2,051	-1,619	-1,198
6	Uptake in CO_2 terms	- 8,659	-7,519	-5,935	-4,392

Total C released (on and offside burning) 7916.80 kt

C released from decay of above ground biomass 1184.76 kt

C released from soil 8240.10 kt

As evident from the table, there were no net GHGs emissions from the forestry sector either in the reference year 1990 or up to year 2020. Thus, forests could serve well as a net carbon sink in Myanmar for many years to come. However, total carbon emission from the forests for the base year was 17.34 Mt. Thus, forest depletion and degradation rate is frightening, and unless remedial measures are undertaken in time, will threaten the environmental and ecological stability of the country leading to a rapid climate change.

8. Conclusion

Myanmar is still in possession of a considerable extent of forest cover which is attributable to the scentific management continuously praticied for a century and a half. Life-supporting prestine natural forests continue to flourish in many parts of the country. As indicated by the results of the national GHGs inventory there were no net carbon emission in 1990 and the situation would remain so for the projected years till 2020.

The Forest Department of Myanmar has not only been effectively conserving the existing natural forests but also assisting natural regeneration and enriching them in terms of density and value. Complementary to this effort determined re-afforestation activities are being undertaken by both the state and the people. These efforts will doubtlessly enhance both the tangible and intangible productivity of these valuable natural resources for the socioeconomic well being of the nation, and also promote carbon sequestration, thereby, mitigate global warming and climate change.

The threat of climate change is a global concern and thus, the global community is urgently called for to effectively conserve existing forests and increase the momentum of the re-afforestation programme. Myanmar exerts all-out effort in sustainable forest management in general and reafforestation in particular to help secure environmental and ecological stability, and build up a net carbon sink while adhering to its ultimate objective of sustainable development in the forestry sector.

資料３．海外研修ワークショップ講演資料集(英文)

「西ジャワのマンギウム、メルクシマツ、ラワンの炭素固定」

森林環境研究所長　Dr. Fauzi A. Masu'd

CARBON STOCK ESTIMATES FOR *Acacia mangium, Pinus merkusii* and *Shorea leprosula* PLANTATIONS IN WEST JAVA, INDONESIA

Ika Heriansyah[1], Chairil Anwar Siregar[1], N.M. Heriyanto[1], Kiyoshi Miyakuni[2] and Tsuyoshi Kato[3]

INTRODUCTION

Under the Clean Development Mechanism (CDM) activities, carbon stock change in forest plantation must be monitored easily and accurately to obtain carbon credits. Formulation of allometric equations is one of the most appropriate ways to estimate tree biomass and carbon stocks.

This paper formulates the simple allometric equation of *Acacia mangium, Pinus merkusii* and *Shorea leprosula* which also can estimate root biomass. Data were obtained from survey in West Java, Indonesia. This research project was conducted as part of the Demonstration study on carbon fixing forest management in Indonesia, with the cooperation of FORDA and JICA.

METHODS

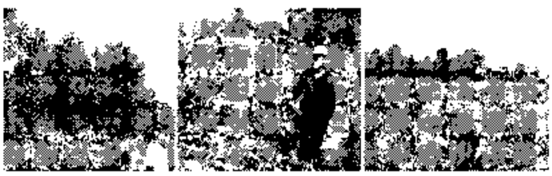
1). Estimates the forest biomass

Four plots of 0.06 ha (20m x 30m) were established in each site. Stem diameter at breast height (DBH) was measured for all trees. Tree height (H) was also measured.

2). Formulate allometric equations

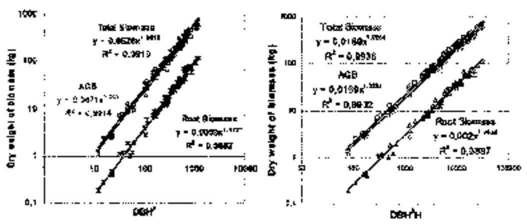
Fifteen sample trees were cut down around the each plot. Tree size as DBH, H, and weights of stem, living- and dead-branch, leaf and root were measured in the field. Samples were brought to the laboratory to measure oven-dry weight. Each sample was dried using a constant temperature oven. Drying took two days (85°C) for leaves and woody biomass under 10 cm in diameter, and four days (85°C) for woody biomass over 10 cm in diameter.

RESULT

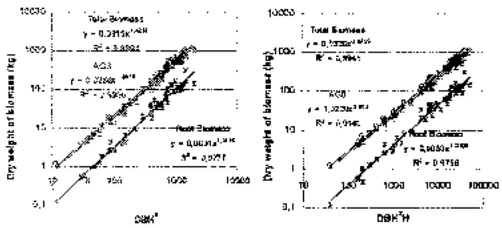


Newly plantations of *Acacia mangium, Pinus merkusii* and *Shorea leprosula* (Photograph by Ando)

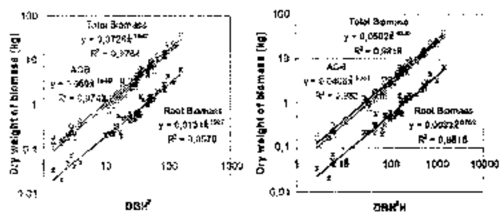
Allometric equations



Allometric equations of *Acacia mangium*

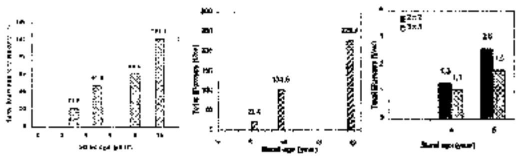


Allometric equations of *Pinus merkusii*



Allometric equations of young *Shorea leprosula*

Forest Biomass



A *B* *C*

The biomass of *Acacia mangium* (A), *Pinus merkusii* (B) in each stand age and *Shorea leprosula* (C) in each stand age and spacing

CONCLUSION

We determined accumulation tree biomass per hectare and age-related changes, included root biomass by mean of destructive sampling technique and used it to estimate carbon stock of *Acacia mangium, Pinus merkusii* and young *Shorea leprosula* plantations in West Java, Indonesia. Our study showed allometric equations using data obtained from field survey, total biomass was estimate using those equations, carbon stock and also CO_2 absorbed capacity by plantations.

The possibility of formulating a single allometric equation applicable regardless of stand age was demonstrated, provided that age was less than 10 years old for *Acacia mangium*, less than 24 years old for *Pinus merkusii* and age was less than 5 years old for young *Shorea leprosula* plantations.

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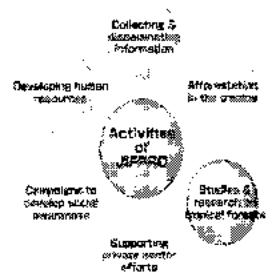
[3]Japan International Cooperation Agency, Carbon Fixing Forest Management Project, Indonesia.

CDM Forestation Project

Items to be cleared with host organizations
-from the view point of Investors-
JIFPRO Lombok Project as a sample

1

Activities of JIFPRO



- Forestation Activities

Target:Socio-economic improvement
Local environment improvement
Land rehabilitation
Carbon sequestration

- Malaysia - 1,344ha
- Viet Num - 738ha
- Myanmar - 1,300ha
- Thailand - 52ha
- Indonesia - 1,002ha
- Total 4,436 ha

in 2003

2

Forestation Projects in Indonesia

- Friendship Forest by EPSON

in South Kalimantan - 300ha-

- Community Forests by Green Fund & others

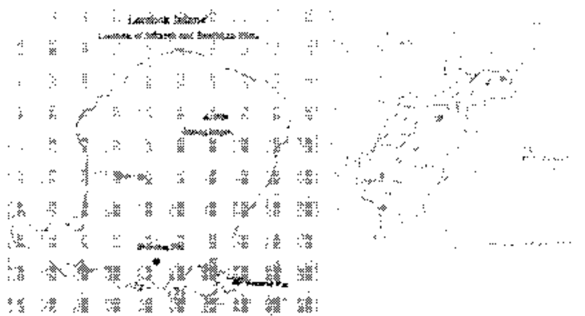
in C. Java & W. Java -- 235ha-

- Indonesia-Japan Friendship Forest

in Lombok, NTB -480ha-
AIJ candidate Project

3

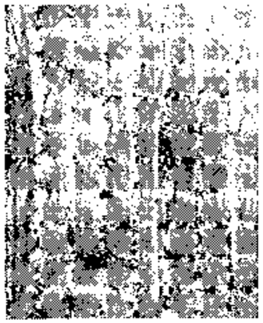
Lombok Project Site



4

Outline of JIFPRO Lombok Project

- Name : Indonesia-Japan Friendship Forest
- Phase Ⅰ: (1996-1999)
- Acreage : 350ha
- Counterpart Organization : DINAS KEHUTANAN
- Trees: Timber, MPTS, Fruit
- Target: ・Land rehabilitation, ・Local socio-economy, ・Local environment, ・Carbon sequestration



5

Land Use at the End of 1989

- Afforestation or Reforestation after 2000

sorry! JIFPRO Lombok Project is out of the criteria

- Non-forest Area at the End of 1989
- What is Forest?

⇨ Minimum area 0.05-1.0ha
Minimum crown coverage 10-30%
Minimum tree heights of mature trees 2-5m

(Indonesian Government would decide the criteria)

6

Involvement of low-income community

- Small scale CDM project

less than about 3-500ha, its rule becomes simple

- Organize local cooperative or collaboration body

developed or implemented by low-income communities & individuals determined by Indonesian Government

- Involvement of Regional Administration Office

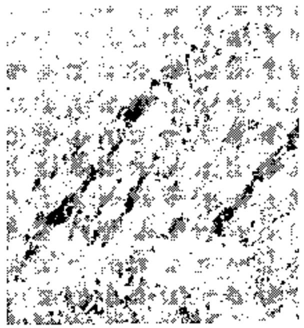
land for CDM project is national land

- Construction of triangle operation system

triangle operation system is a safe measure for investors

7

Environmental Impacts



- Monitoring
- Water supply
- Soil conservation
- Endangered animals & plants
- Bio-diversity
- Invasive plants

Indonesian Guideline

8

Socio-economic Impacts

- Involvement of local community
- Impact to local economy
- Job creation
- Opinions of stakeholders
- Operation of project

Indonesian Guideline

9

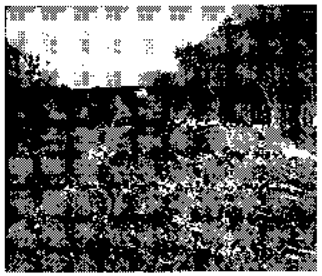
Risk Management & Emission Management

Risk Management Records

- Forest Fire
- Drought & Natural Disaster
- Pests (insect, disease)

Forest Management Records

- Vehicle
- Forest products
- Cattle



10

Approval by DNA

- PDD (Project Design Document)

⇩

- Approval by DNA of Indonesia & Japan

  Investors want QUICK approval
- PDD ⇨ CDM-EB & OE

11

Predicted cost of CO_2 by CDM

- US$3～6/t$CO_2$ by emission reduction Project in EU market
- US$14/t$CO_2$: an example of plantation CDM in east Kalimantan

But!!

Big Plus+ to Local Socio-economy, Local Environment, Land Rehabilitation, Job Creation, Bio-diversity & many

12

JIFPRO SINGKARAK LAKE AFFORESTATION PROJECT

By

Nagari Paninggah... DA
INKOPTEK TANHU...

WEST SUMATERA

The Challenge

- Surrounding Singkarak Lake
  - 399,095 people, 205 per km2; 30% u... poverty line; 4,559 families shifting cu... in 10,624 ha of poor land.
  - Main source of income are agriculture an... fishery in to the lake (76,5%)
  - AR- CDM Project encourage community maintaining natural resources and assist alleviate their poverty as well as increase carbon sequestration

INDONESIA

Background

- Paninggahan Village collaborate with Forest Research and Development Agency (FORDA), Main Cooperative for the Improvement of Technology and Agroforestry Community Welfare (INKOPTEK TANHUN), ...d Bogor Agricultural University (IPB)
- Financial Assistance from the Japan Inte...l Forestry Promotion & Cooperation Center (JIFPRO) mount of $ USD for the first 5 yea...
- Maximum For 20 years which may be renewal ... most two times. (Renewal means updating) activities in Singkarak Lake Watershade in implementing of Afforestation and Reforestation Clean Development Mechanisms (AR-CDM) small scale project

Challenge (continue)

- Stewardship of natural resources still not so good and this project will help in creating ...rtnership system of stakeholders with communit...
- The constrain to ask the upland poor com...es involve in improving environmental conditi... Singkarak Lake through afforestation activitie... Financial support for good planting material as well as land cultivation and maintenance;

The Site

- Singkarak Lake about 21 km le... th 16 km m width depth 160 m; size 13,665 ... 360 m above sea level; surrounded by 12... ha water catchments; located in central of West Sumatera formerly Minangkaba... Kingdom.
- 30% of the water catchments area covered by alang-alang (*Imperata cilindrica*)

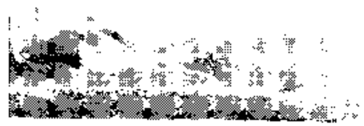
SINGKARAK LAKE

Communities actvities

Site (continue)

- There is electricity generators (P...A) which provides for West Sumatera and Ria... provinces (about 986 GWH per year)
- From Singkarak Lake provide water for ir... rise paddy in Solok, Padang Pariaman, Tana... Datar and, Swahlunto Sijunjung Districts; An... Ombilin Coal Mining.
- There are 17 villages surrounding of Singkarak Lake.
- There are three climatic condition; Wet area in the Western, dry area in the Eastern and, medium area in the Northern part of the Lake.

SINGKARAK LAKE WATERSHED



Site (continue)

- Underway activities compliment... JIFPRO:
  - Community developed cooperativ... for improving community Economy an... ...nkarak Lake Environmental Condition(PERLI...
  - Communities developed controlled road... surrounding the 700 ha land that are gon... be planted, however, the road is still low in quality
  - In Paninggahan village Nagari created Village Regulation on Forbidden River to conserve ikan bilih (exotic fish); Village community develop Senior Height School and Rehabilitate Paninggahan market

Site (continue)

- Community in each Nagari at the si traditionally are grouped called Suku, under suku t several Kaum. each Kaum headed by Ninik Ma Ninik Mamak has the authority to the clan (tanah ulayat kaum) which used for improvin prosperity every member of Kaum.
- Other traditionally grouped community are grouped by cooperative .
-

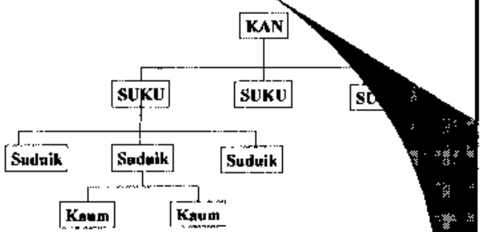
Program Justification

- Fit with national policies in rehabil e through afforestation and reforestation with in ement of local peoples
- Automatically will address poverty allevia example plant material used for rehabilitatio including tree crops, fruit crops as well as tree forest.
- This project will help to understand how afforestation can best implemented and will improve the livehood of upland communities
-

Program justification (continue)

- Will get an appropriate institutional stem to support the implementation of JIFPRO Afforestation Project.
- Will govern the implementation of afforest activities in carbon services (DNA).
- The main proponent and it partners to undertak this project are good understanding on the issues at Singkarak Lake.

INFORMAL GROUPS (ADAT)



Program justification (continue)

- Will be benefits such as carbon sequastration (carbon trading), bio rsity (in the lake and forest ecosystem) wa yield and quality.
- The critical information the project migh provide is suitable working of best practices for successful implementtation of afforestation JIFPRO Project:

Overall Development Objective

- ***Programme Goal***
- The goal of this project is to suppor build the capacity of local communities, ins and government agencies in the Sing watershed to implement environmental serv to promote sustainable natural resour management and poverty alleviation among po upland communities.

Objective 1: To establish appropriate institutional arrangements for transfer technology, agreements, monitoring system and enforcement mechanisms following the process on the site.

Objective 2: Compile and disseminate best ...tices and lessons learned from these projects to raise awa... at all levels on how the transfer of technology in af... services can benefit upland communities.

Long-term Results:

- Local, regional, national, and international capacity to implement environmental services effectively;
- Improved natural resource management among upland areas;
- Improved livelihoods among poor upland commu...
- Additional programmes that can be proposed for ... promote environmental services compensation ... ensuring flowback of benefits to poor upland communiti...

Budget

- The break down of the budget in each activities are shown later in Framework Budget Requirements over 5 years activit...

Outputs Expected

- Information and capacity building: Awareness of local communities on the opportunities to have economic benefits from the afforestation will increase
- As well as capacity to quantify the environme... services and to develop project concepts related to environme... services, such as carbon-sink projects.
- A suitable working of best practices for ... implementation of afforestation, i.e. an appropriate ins... arrangement for transfer technology, agreements, mo... system and enforcement mechanisms.

Spacific Activities

Activity 1. Conduct a number of roundtable discussions with key actors to set up alternative system of implementing afforestation transfer mechanisms technology.
Activity 2. Conduct the preparation of seedling w... are going to be planted in the area
Activity 3. Conduct the improvement of the quality o... road surrounding the area that are going to be planted
Activity 4. Land cultivation, planting and maintenance of the area which are surrounded by controlling roads (700 Ha)
Activity 5. Quantification the carbon benefit generated by fore... projects (e.g. agroforestry systems) in Singkarak Lake
Activity 6. Analysis of the impact of forest cover change on water ...

Formal discussion

TECHNIQUE TO MONITOR CARBON IN CDM-LULUCF PROJECTS[1]

A.Ngaloken Gintings[2]

INTRODUCTION

At article 3.3 of the Kyoto Protocol 1997, stated that the net changes in greenhouse gas emissions by sources and removals by sinks resulting from direct human-induced land – use change and forestry activities, limited to afforestation, reforestation and deforestation (ARD) since 1990.

Through long-period of negotiation process, decision on procedure and methodological aspects of LULUCF that included afforestation and reforestation in CDM was finally taken in COP-9 which was held in Milan, Italy 1 – 13 December 2003. A number of outstanding issues were settled for example : definitions, provision for monitoring, crediting period, addressing non-permanence, size of small-scale CDM project, and criteria for assessing environmental and socio economic impacts.

Procedure on 'small scale CDM' forestry will be decided on COP-10, therefore it is needed to know the mechanism which can be implemented in the future.

Eventhough the CDM-LULUCF do not get into force yet, the afforestation and reforestation factors should be monitored properly, as the basic data for CDM-LULUCF project in the future. Each stakeholder is hoped familiar with the technique to monitor carbon in CDM-LULUCF projects.

TECHNIQUE TO MEASURE CARBON IN PLANTATION

As decided on COP 9, afforestation and reforestation are including the CDM. In order to know the capacity of plantation to absorb carbon, it is needed to know the method to measure it.

In general the method to measure the carbon in plantation is based on its corresponding biomass stuffs.

The sequence activities to measure the biomass are as follows:

A.Plot setting.

1. Field survey to know the homogenity of stands. For the homogenous stand and estimate of the same biomass, the size is measured. Besides, the location, elevation, direction, climate, soil type and plantation amangement, are also recorded.
2. Develop the plot purposively. The length of the shortest side of the plot must be longer than the mean height of the trees within the plot. For example, if the mean tree height is 16 m, the size of the plot is large than 16 m x 16 m.

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[1] Paper presented at International Workshop on Developing Local Capacity for the Implementation of CDM-LULUCF Projects, Bukittinggi March 13, 2004

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3. Measure the diameter at breast height of every standing tree. The dead trees in the plot are also counted so that the stand density and survival rate can be known.
4. Establish four representative small plots with the size 2 m x 2 m for the measurememnt of ground cover matters. From each plot, the grass and shrub are sparated and weighed. The sample of grass and shrub is taken, weighed, put into paper envelope and labeled.
5. Select sample of the felled trees based on the diameter class. The total number of tress felled in each plot is 3-5, with variation of diameter from small to big.
6. Tree felling at 0.3 m above ground.
7. Measure the trunk portion which is free of branches.
8. Measure the trunk and cut each into log with the length size of 1.0 m; 2.0 m; 2.0 m and so on until the end of free brunch, for the convenience of weighing. For each log is numbered and recorded.
9. After weighing the entire mass of each log, take same representative small-size portion of the log as sample, weigh them, placed into the paper envelope and than labeled. Bark and wood portions are weighed separately, and so are the small bark and wood portion as samples.
10. Boughs, twigs, small branches, and leaves are collected, then weighed separately, and put into separate poly vinyl sheet. For the determinate of moisture contents and dry weight mass, take small-size portion of each of them, weighed, put into the paper envelope and labeled.
11. Cut the remaining stump which is as high 0.30 meter as above the ground, weighed. Likewise, for the determination of moisture content and dry weight mass, take small-size portions of the stump, weighed, and then put into paper envelope and labeled.
12. Digging all the roots, and removed the soil.
13. Weighed the root, and take it sample, weighed, and put into paper envelope and then labeled.
14. Weigh the overall grass from the ground cover plots. Correspondingly take the small portion of such ground cover, weighed, put into paper envelope and then labeled.
15. Weigh the stems of shrubs that also constitute the ground cover matters, correspondingly, take small portion as sample, weighed, put into paper envelope, and than labeled.

B. Requirement for sample :

1. Trunk : 2 – 4 cm thick
2. Boughs : 0,3 – 0,5 kg, various diameters and 10 cm in length
3. Twigs : 0,5 – 1,0 kg, various diameters and 10 cm in length
4. Leaves : 0,3 – 0,5 kg
5. Stumps : 2,0 – 4,0 cm thick, and its barks is sparately.
6. Roots : 1,0 – 2,0 kg
7. Leaves of ground covers : 0,1 – 0,3 kg
8. Stems of shrub (ground cover) : 0,1 – 0,3 kg

C. Tools :

1. Compass
2. 50 m tape measure
3. Tapes for enclosing the plot
4. Diameter measuring tape
5. Haga instrument, to measure the height of trees
6. Field note
7. Balance : 1 – 100 kg and 0 – 20 kg
8. Electronic balance
9. Chain saw
10. Hoe
11. Big fork
12. Crowbar
13. Small saw
14. Pruning shears
15. Small and large paper envelope / bags
16. Small plastic bag
17. Ground Vinyl (2m x 5m), four pieces
18. Big plastic bag
19. Label
20. Plastic roof
21. Spidol
22. chopping knife

D. Activities it Laboratory:

1. Put the wood sample into the oven with 80 - 90°C temperature for arround 96 hours to reach the stable weight. This weight is called dry weight of the sample.
2. Put the bark sample into the oven with 80 - 90°C temperature for arround 48 hours to reach the stable weight, as dry weight of the sample.
3. Put the bough sample into oven with 80 - 90°C temperature for arround 48 hours to reach the stable weight, as dry weight of the sample.
4. Put the twigs sample into oven with 80 - 90°C temperature for arround 48 hours to reach the stable weight, as dry weight of the sample.
5. Put the leaves sample into oven with 80 - 90°C temperature for arround 48 hours to reach the stable weight, as dry weight of the sample
6. Put the stem of shrub (ground cover) into the oven with 80 - 90°C temperature for arround 48 hours to reach stable weight, as dry weight of the sample.
7. Put the root sample into the oven with 80 - 90°C temperature for arround 48 hours, to reach stable weight, as dry weight of the sample.

E. Estimating biomass :

1. The biomass of wood stem which is free of branches is the total dry weight of all pieces of the stem part (log). The biomass of the log is computed as follow : Dry weight of wood stem sample divided fresh weight of wood sample, and than multiplied by the fresh weight of the log.

2. The biomass of wood bough is the total dry weight of boughs, and computed similarly as point 1.
3. The biomass of wood twigs is the total dry weight of twigs, and computed similarly as point 1.
4. The biomass of leaves is the total dry weight of leaves. The biomass of leaves is computed as follow: Dry weight leaves sample divided fresh leaves sample, and than multiplied by total fresh weight leaves.
5. The biomass of bark is the total dry weight of bark, and computed similarly as point 1.
6. The biomass of roots is the total dry weight of roots, and computed similarly as point 1.
7. The biomass of ground cover is the total dry weight of ground cover, and computed similarly as point 1.

Based on the above method, the estimate biomass of the felled trees and of their ground cover matters can be known.
In order to know the biomass of tree stands per hectare, the number of trees growing in one hectare is used. The mean biomass of felled trees multiplied by total number of tree stands per hectare (in kg or ton). Further, for the ground cover matters, is used the mean biomass weight of ground cover existed as the plot measuring 2 m by 2 m, and for the determination of biomass weight of grass cover on one hectare site is counting 10,000 m^2 devided by 4 m^2, than multiplied by the average weight in 4 m^2 site (in kg or ton).

The accurate method to estimate the tree stand biomass is to use allometric relation between diameter and its total dry weight as follow :

$TDW = a .(DBH^2)^b$ or $\ln TDW = \ln a + b. \ln(DBH^2)$

where : a and b is coefficients
TDW : Total dry weight
DBH : Diameter at breast height

Based on the measured diameter of all trees in oned hectare area, its biomass weight can be computed based on allometric equation above.

The carbon content is 0,5 the biomass and the corresponding CO_2 = 44/12 x C (in kg or ton).

As example :
Acacia mangium at three years old its biomass weight is 45 ton/ha.
It means : Carbon contents = 0.5 x 45 ton/ha = 22.5 ton/ha
Its CO_2 = 44/12 x 22.5 ton/ha = 82.4999 ton/ha

As an addition matter, since in the COP 9 there has been decided the definitions, provision for monitoring, crediting period, addressing non-permanence, size

of small-scale CDM project, and criteria for assessing environmental and socio economic impacts,
the below information should be considered :

1. Afforestation is grow trees in the area where 50 years before the year 2000, are not covered by trees.
2. Reforestation is grow trees in the area where in 31 December 1989 is forested.
3. Tools to prove the area for afforestation and reforestation.
4. Credit period, should be decided by both parties, which one is most profitable.
5. Non-permanence, for example the short rotation of plantation.
6. Small scale CDM, the size of plantation, species, rotation, increament, and the price of timber should be considered.
7. Criteria for assessing environmental and socio economic impacts should be decided for each specific location.

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Carbon Sequestration of Man-made Forests in Relation to AR-CDM

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Summary: Carbon accumulation of industrial plantations in the Southeast Asia is about 10 tC/ha/yr in productive sites. The carbon accumulated by tree planting to rehabilitate degraded lands is not always less than that of industrial plantations. Selecting the suitable species could be one of the most essential factors to succeed in establishing and preserving forests. Rehabilitation forests in Lombok Island and Benakat in South Sumatra sites would be regarded as the successful cases for that matter.

While the annual carbon accumulation by naturally regenerated vegetation at base lines in Lombok site amounts to 2.9~3.2 tC/ha/yr, the net carbon accumulation (subtracting the amounts at base line from the carbon sequestration of planted trees) of this site ranges from 2.9 to 5.7 tC/ha/yr. Establishing forests has markedly increased the carbon accumulation in this area. The carbon accumulation at baselines at Benakat site is 1.6~2.8 tC/ha/yr. It is almost the same as that of Lombok site. The above-ground carbon dry weight of 20-year-old *S. macrophylla* planted for rehabilitation purposes is 6.6 tC/ha/yr. These results suggest that, in short rotation, the carbon accumulation of rehabilitation forests is not markedly different from that of industrial plantations. Conserving the rehabilitation forests for a long time would, therefore, be one of the most rational practices for storing carbon on degraded lands sustainably.

INTRODUCTION

Incomes, expenses, and savings

Tree/forest growth can be interpreted as a budget and be itemized as incomes, expenses, and savings. Photosynthetic production can be signified as income, respiratory loss as expenses and growth as savings. Low savings can therefore be the result of "low income and high expenditure", "high income and high expenditure" or "low income and low expenditure".

In the earlier stage of tree growth, the income generated from the formation of its crown or canopy is high, and the surplus (photosynthetic production-respiration in the crown or canopy) with energy input sufficiently provides the tree with organic matters for new growth in foliages, stems, branches, and roots.

In the mature stage or climax stage, the maintenance costs of the stems, branches, and roots increase owing to their enlarged quantity, signifying the increased expenditure. In the stage thus, and further advanced, incomes decrease due to the structural factor of tree as being spatial i.e., the photosynthetic production is hindered by chronic water stresses owing to the further elongated distance that lies between the tree crown and the root system.

Low income means low distribution of organic matters to non-photosynthetic parts. If the fine root growth is disturbed, absorption of water and mineral nutrients declines, which in turn worsens the water stresses in the crown.

Role of forests in carbon sequestration

For easy understanding, the author would like to illustrate the process, using the goods (carbon dioxides) and warehouse (forests) relations. Forest growth means the increasing storage of goods and the size of warehouse. The warehouse, nonetheless, has limitation in size and it will be occupied to the fullest extent by goods, eventually. That is the stage of the climax forest, and in terms of goods and warehouse relation, there is no more goods coming into at this stage. This signifies the stage of no more room for the role of forest to play in carbon sequestration.

If a forest fire should occur, carbon dioxides would get released into the atmosphere just in the same manner as the goods gets released from the warehouse when it catches on a fire. In the long term perspective, such as 200 to 500 years, the carbon dioxide or goods exists only temporarily in the warehouse or trees/forests because of the life cycle of trees/forests and because such naturally caused damages on forests as natural fire, cyclone, etc., occurs frequently. Therefore, there is no room for the forest to play its role in carbon sequestration when considering such a long time span. For this reason, when we evaluate the role of forests in carbon sequestration, time span should always be kept in our mind. Debates, therefore, on carbon sequestration of forests in relation to CDM of the Kyoto Protocol should take the time span into account.

Another serious problem that we have to keep in our mind is the decreasing warehouses, in another word, deforestation, which is one of the major concerns of global environment. We are strongly reminded, here, that the warehouses be conserved and maintained in regional, national and global levels.

As a measure of increasing the sizes of warehouses, utilization of forest products is strongly recommended. Utilization of wood in building houses and in other construction purposes increases warehouses outside the forest area. Nevertheless, here as well, the time span, that we have to remind ourselves of, shall always be taken into account of when we evaluate the role of these forest products such as houses because they have a limited life span as a warehouse. The goods go out of the warehouse after their life span is up.

An important role that the forests products (trees in particular) play in the matters of global environment is the very fact that the forest products can reduce the dependency on limited fossil fuels. It is reassuring to know that they are renewable by making best use of solar energy that abounds on earth.

CDM

Clean Development Mechanism (CDM) is stipulated in Article 12 of Kyoto Protocol. It has been agreed to include carbon-sink roles of afforestation and reforestation in CDM(AR-CDM). In the near future, it is expected that CDM related plantation activities be discussed and practiced in various countries. It may, then, be important to provide scientific information on carbon accumulation in man-made forests and its bearings on AR-CDM for policy makers.

It is important to ascertain how much carbon is accumulated if plantation forests are established for the AR-CDM application. Carbon accumulation of naturally regenerated vegetation that is considered to be "baseline" without additional carbon sequestration activities is not regarded as the increment resulted from AR-CDM practices. Furthermore, in order for such carbon sequestration activities to be certified as AR-CDM practice, it is presently so regulated that the carbon accumulation of man-made forest has to amount to higher than that of the baseline.

In terms of carbon sink activities, baseline means the carbon accumulations of secondary forests, grasslands, pastures, cultivated lands and various land uses other than tree planting. Nevertheless, there is little information about carbon accumulation in such non-tree planting vegetation. Recently, vegetation with 2 to 5m high is regarded as forest after the decision of COP 9. Therefore, most secondary forests won't be made the target of AR-CDM.

This paper, therefore, deals with the verification of carbon accumulation from the viewpoint of man-made forests. Some of the case studies were conducted and basic data was collected.

We measured the carbon accumulation in man-made forests with some typical fast growing species, and discussed the difference of accumulation rate between different plantation types, industrial plantations and rehabilitation forests. In addition, we discuss carbon accumulation of pioneer secondary forests, shrub lands and grasslands established after forest fires, shifting cultivation and/or logged over plantation areas to treat as baselines.

BIOMASS ESTIMATION

When we estimate biomass in various stands, applying a sampling method by felling trees may be difficult in tropical area due to the lack of measuring tools and drying oven. Therefore, estimating biomass without destructing stands is needed. Allometric relation between dry matter of each organ and diameter at breast high (DBH) will be suitable if the relation in each species can apply to various stands.

$Y = aX^b$...................(1)

(Where Y is dry matter in each organ, X is square of DBH, and a and b are coefficients.)

Recently, data set from our field works has been completed with coefficients in allometry of various tree species of industrial plantations and rehabilitation forests.

RESULTS AND DISCUSSION

Industrial plantations

Fast growing tree plantation is established mainly for the purpose of producing pulpwood supply and the cycle between planting and harvesting is 6 to 8 years as a general practice. Five to 7 years' rotation is suggested for higher products of pulpwood (Yonekawa and Miyawaki, 1988).

Stands are generally selected at high productive site for efficient income generation from the wood products. Main species in industrial plantations in tropical and subtropical regions are such fast growing species as *Eucalyptus* and *Acacia* species.

<*Acacia*>

Acacia mangium is widely planted at various sites in secondary forests, shrubs and grasslands after forest fires, abandoned shifting cultivation areas, and/or logged over plantation areas. Mean annual increment (MAI) of the above ground biomass of this species, including leaves and branches, is about 10tC/ha/yr. This figure may be applied to plantations of this species in Monsoon Asia. Root biomass is about 16% to above ground biomass from the industrial plantation in Benakat, South Sumatra.

MAI of *A. auricliformis* fluctuates in various sites. These fluctuations may be caused due to the differing purposes of each plantation. This species is planted widely in productive or degraded lands for its high adaptability to dry environment and poor soil conditions. This species will be suitable for degraded land rather than high productive land because of their growth performance.

<*Eucalyptus*>

MAI of *Eucalyptus globulus* is about16tC/ha/yr at Manjimup, Western Australia and it might be the highest among the industrial plantation. MAI of another species, *E. grandis* in South Africa and *E. nitens* in Chili ranged from 8 to 11 tC/ha/yr. Root biomass is 14 to 16% to above ground biomass in these species. These species are suitable for subtropical regions.

E. camaldulensis introduced from Australia is widely planted in Monsoon Asia especially in Thailand (Kamo, 1990) as multipurpose tree for social forestry (Ishizuka, 1996a, b). Its MAI is about 5tC/ha/yr at Sonbe, Viet Nam and lower than the amounts of *A. mangium* and *A. auricliformis* at the same site. The volume growth is annually about 20 cubic meters in dry tropical regions and is about 30 cubic meters in wet regions (Ishizuka, 1996a, b). The growth is strongly affected by site conditions in spite of higher growth adjustment capability to environmental stresses (Ishizuka, 1996a, b).

Rehabilitation forests

Establishing forests in degraded land gives us social benefits such as water conservation, erosion control, agricultural use of litter, and commercial wood products. MAI of 3-year-old *Cassia siamae, Azadirachta indica* and *Dalbergia latifolia* plantations is 6 to 9tC/ha/yr in Lombok Island, Indonesia for the purpose of round wood, fuel wood, and fodder productions.

MAI of 20-year-old *Swietenia macrophylla* plantation is 6.6tC/ha/yr at Benakat, Sumatra. These plantations were established by the effort of JICA for rehabilitating degraded land after severe shifting cultivation. The plantations are well managed for a long time protecting from fire and illegal logging by the local forestry office. Root biomass is about 30% to above ground in this species. Higher portion of root biomass may be important to improve carbon sequestration and commercial values of forests.

Industrial plantation with short rotation may be effective to carbon sequestration in short period. We, therefore, need to study the carbon sequestration and release in the cycle of 6 to 9 yeas with a view to sustaining continuous carbon sequestration. On the other hand, rehabilitation forests obviously accumulate carbon for a long time even with their slow growing characteristics.

Base line

Carbon accumulation in perennial grass and shrub (*Chromolanea odorata* and *Lantana camara*) is 2.6 to3.2tC/ha/yr at degraded land in Lombok Island, Indonesia. These species have short life span. *C. odorata* accumulates carbon of 10tC/ha in three-years-old and the accumulation decreases to 8.3tC/ha with increasing dead organs in 5-years-old (Slaats et. al., 1996). This species is commonly growing in the area after forest fires in Borneo for 2 years. However, it completely disappeared from the area after 3 years (Nykvist, 1996).

Secondary forests after forest fires accumulated carbon of 2.9 to 5.7tC/ha/yr at Bukit Soeharto in East Kalimantan. These amounts are higher than those of herbs and shrubs in Lombok Island. This might be caused by the species composition in secondary forests. In *Macalanga gigantea* plot, carbon accumulation is relatively lower in trees and higher in forest floor vegetation. Carbon accumulation seems to be lower in pioneer secondary forests than man-made forests in spite of fast growing after forest fires.

Preliminary expectations of carbon gain in CDM

Three hundreds and thirty seven million tons of carbons were released in the atmosphere in 1990 in Japan. If we would try to sequestrate one percent of these released carbons through the use of CDM, Japan would need 581 thousands ha of land in developing countries to plant trees based on the carbon sequestration of 8.8tC/ha/yr in man-made forests and 3tC/ha/yr in baselines (above ground).

Japan Overseas Plantation Center for Pulpwood (2001) expects 196.5 thousands ha plantations in 2000 and 213.9 thousands ha in 2010 respectively. It is, therefore, clear that other types of CDM projects should also be earnestly pursued and other effective measures be taken in Japan.

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Table 1 Carbon Accumulation in man-made forest and base line (BL)

Species	Site*	Age	Density (n/ha)	Carbon (tC/ha) and MAI (tC/ha/yr) stem	bark	branch	leaf	above	root	Stem volume (m^3/ha)	BL (tC/ha/yr)	Source
Eucalyptus globulus	1	5	1225	55.3 (11.06)	9.3 (1.86)	8.5 (1.70)	8.5 (1.69)	81.5 (16.30)	12.2 (2.44)	246.2		yamada et al, 1999
Eucalyptus globulus	1	8	1225	93.5 (11.69)	13.5 (1.69)	11.4 (1.43)	10.2 (1.28)	128.5 (16.06)	18.5 (2.31)	408.9		yamada et al, 1999
E. globulus	2	5	1467	29.1 (5.82)	3.8 (0.77)	6.1 (1.22)	5.0 (1.00)	43.0 (8.60)	7.3 (1.45)	144.5		JOPP, 2000
E. globulus	2	7	1840	52.0 (7.43)	6.6 (0.94)	8.1 (1.16)	7.2 (1.03)	74.0 (10.57)	12.5 (1.79)	254.7		JOPP, 2000
E.grandis	3	5	1135	30.8 (6.16)	4.1 (0.82)	2.9 (0.58)	1.6 (0.32)	39.4 (7.88)	8.9 (1.78)	198.3		Yamada et al, 2000b
E.grandis	3	8	1333	53.7 (6.71)	6.4 (0.80)	4.7 (0.58)	2.2 (0.27)	66.9 (8.36)	8.9 (1.11)	338.2		Yamada et al, 2000b
E. nitens	2	7	1383	41.6 (5.94)	5.2 (0.75)	6.7 (0.95)	7.6 (1.08)	61.1 (8.73)	10.0 (1.43)	223.9		JOPP, 2000
E. nitens	2	8	1517	45.9 (5.74)	5.8 (0.73)	7.3 (0.91)	8.4 (1.05)	67.5 (8.44)	11.1 (1.39)	247.8		JOPP, 2000
E. nitens	2	11	1048	68.5 (6.23)	7.7 (0.70)	10.6 (0.96)	10.8 (0.98)	97.6 (8.87)	15.5 (1.41)	345.1		JOPP, 2000
E.camaldulensis	4	6	1089	20.1 (3.35)	4.7 (0.78)	2.0 (0.33)	0.9 (0.14)	30.5 (5.08)	(0.00)	75.1		Yamada et al, 2000a
Acacia mangium	4	6	1289	46.3 (7.72)	7.8 (1.29)	4.9 (0.82)	1.7 (0.28)	60.6 (10.10)	(0.00)	229.0		Yamada et al, 2000c
A. mangium	5	6	1369	57.3 (9.55)	9.2 (1.53)	16.4 (2.73)	3.2 (0.54)	86.1 (14.35)	13.2 (2.20)	287.4	1.6-2.8	JIFPRO, 2002
A. mangium	6	7	506	42.3 (6.04)	4.0 (0.57)	6.1 (0.87)	2.3 (0.33)	54.6 (7.80)	(0.00)	221.9		Yamada et al, 2000a
A. auricliformis	4	6	1500	33.9 (5.65)	5.1 (0.84)	6.3 (1.05)	2.7 (0.44)	47.9 (7.98)	(0.00)	171.4		Yamada et al, 2000a
Cassia siemea	7	3	935	12.4 (4.13)	1.7 (0.55)	9.8 (3.25)	2.1 (0.70)	25.8 (8.60)	(0.00)	37.3	2.6-3.2	Morikawa et al, 2002
Cassia siemea	7	5	988	28.2 (5.64)	3.4 (0.68)	31.0 (6.20)	5.0 (1.00)	67.6 (13.52)	22.0 (4.40)	44.1	1.2-1.6	JIFPRO, 2003
Azadirachta indica	7	3	1111	11.3 (3.77)	2.1 (0.68)	7.2 (2.38)	2.3 (0.77)	22.8 (7.58)	(0.00)	44.4	2.6-3.2	Morikawa et al, 2002
Azadirachta indica	7	5	1605	43.0 (8.60)	7.1 (1.42)	35.1 (7.02)	8.3 (1.66)	93.4 (18.68)	23.6 (4.72)	79.9	1.2-1.6	JIFPRO, 2003
Dalbergia ltifolia	7	3	1025	7.3 (2.43)	2.1 (0.68)	7.8 (2.60)	0.5 (0.17)	17.7 (5.88)	(0.00)	26.4	2.6-3.2	Morikawa et al, 2002
Dalbergia ltifolia	7	5	3580	23.1 (4.62)	6.2 (1.24)	31.2 (6.24)	2.0 (0.40)	62.5 (12.50)	14.3 (2.86)	42.6	1.2-1.6	JIFPRO, 2003
Swietenia macrophylla	5	20	1117	81.5 (4.08)	12.0 (0.60)	31.7 (1.59)	4.1 (0.20)	129.3 (6.47)	36.6 (1.83)	437.4	1.6-2.8	JIFPRO, 2002
S. macrophylla	9	16	544	35.9 (2.24)	4.3 (0.27)	8.5 (0.53)	1.7 (0.10)	50.3 (3.14)	19.2 (1.20)	151.6		JIFPRO, in press
Peronema canescens	5	10	446	7.5 (0.75)	1.5 (0.15)	4.4 (0.44)	0.9 (0.09)	14.3 (1.43)	3.0 (0.30)	47.8	1.6-2.8	JIFPRO, 2002
Tectona grandis	10	17	844	20.8 (1.22)	4.7 (0.27)	8.0 (0.47)	2.2 (0.13)	35.6 (2.09)	9.1 (0.54)	86.7		JIFPRO, 2003
T. grandis	10	22	544	25.7 (1.17)	5.0 (0.23)	8.5 (0.39)	2.0 (0.09)	41.2 (1.87)	8.2 (0.37)	139.6		JIFPRO, 2003
Pinus merkusii	9	14	600	69.0 (4.93)	10.3 (0.73)	29.8 (2.13)	4.6 (0.33)	113.6 (8.11)	15.3 (1.09)	277.5		JIFPRO, in press
(secondary forests)	8										2.9-5.7	Morikawa et al, 2002
(alang-alang)	8										0.6-1.3	Morikawa et al, 2002

* 1); Manjimup, West, Australia, 2); Canente, Chili, 3); Melmoth, South, Africa, 4); Sonbe, Viet Nam, 5); Benakat, South Sumatra, Indonesia, 6); Madang, PNG, 7); Lombok Island, Indonesia, 8); Samarinda, East Kalimantan, Indonesia, 9); East Java, Indonesia