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https://doi.org/10.5109/22084

出版情報：九州大学大学院農学研究院紀要. 57 (1), pp.299-308, 2012-02. Faculty of Agriculture, Kyushu University
バージョン：
権利関係：

J. Fac. Agr., Kyushu Univ., **57** (1), 299–308 (2012)

A Comparative Analysis of Carbon Offset Standards for Forest Projects

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(*Received October 26, 2011 and accepted November 9, 2011*)

Korean government confirmed the goal for domestic greenhouse gas reduction, 30% of BAU as of 2020, and is planning to introduce the emission trading scheme to achieve the greenhouse gas reduction goal cost effectively. Internationally, various emission trading schemes are being implemented. The forest sector could not participate in regulated emission trading schemes, EU–ETS in particular, due to non–permanence and leakage, however, is contributing to the fulfillment of the greenhouse gas reduction goal in major voluntary emission trading markets through the participation in carbon offset projects. In the voluntary trading scheme, the issue of non–permanence which is the foremost weakness of the forest sink project is resolved in a variety of ways such as reforestation, buffer credit allocation, and forest preservation pledge. The project also covers various areas such as forest management and REDD in addition to afforestation and reforestation. The forest sector shall participate in the carbon offset project to prove the greenhouse gas absorbing function of the forest and contribute to the fulfillment of sustainable forest management when Korea introduces cap and trade emission trading scheme in the future.

INTRODUCTION

Korea is currently categorized into non–Annex I country in Kyoto Protocol which means that Korea is not obligated to reduce greenhouse gas. However, Korea is a member of OECD and ranked 10th in the world concerning the amount of greenhouse gas emission (as of 2005) that Korea has been continuously asked by developed nations to be included in Annex I or push forward with reduction activities that are differentiated from other developing nations (Presidential Committee on Green Growth, 2009a). Under the circumstances, the government of Korea has made multilateral efforts to reduce greenhouse gas such as establishing as many as four pan–departmental "Climate Change Response Plans" from 1999 to actively cope with climate change, establishing Climate Change Response Team headed by the Prime Minister to implement the plans in September 2001, and operating teams for implementing measures for climate change (Climate Change Response Team under Office of the Prime Minister, 2008; Lho, 2009). Also, President Myung–bak Lee participated in G8 Summit in 2008 and July 2009 and announced that Korea will join the international effort to cope with climate change by reducing greenhouse gas, and on November 17, 2009, Korea set a goal for reducing greenhouse gas down to 30% of BAU (Business As Usual) as of 2020 to implement this announcement (Presidential Committee on Green Growth, 2009a).

To efficiently fulfill pan–departmental effort to cope with climate change and domestic greenhouse gas reduction goal, Korea is also reorganizing laws and systems and the emission trading scheme drew attention in this stage. "Framework Act on Climate Change Response (presented by National Assembly Member In–gi Lee, January 14, 2009)" and "Framework Act on Low Carbon, Green Growth (presented by government, February 27, 2009)" were presented, and Framework Act on Low Carbon, Green Growth passed the legislative proceedings of the National Assembly and was effectuated in full scale from April 14, 2010. The introduction of the cap and trade emission trading scheme was stipulated in Article 46 of the Framework Act on Low Carbon, Green Growth, and the inclusion of the sink project as a means to fulfill greenhouse gas reduction goal by management is stipulated in Article 43 (Facilitation of Earlier Action for Reduction of Greenhouse Gases) of the Act and Article 30 (Goal Management Method and Procedure for Managed Companies) of the Enforcement Decree of the Act to leave the door open for the forest sector to participate in the project (Office of Legislation, 2010). For the introduction of the emission trading scheme, the government established the master plan for emission trading scheme in 2009, conducted pilot project in 2011, and is planning to introduce the scheme fully from 2013 (Presidential Committee on Green Growth, 2009b).

On the other hand, the first commitment period for the reduction of greenhouse gas in accordance with Kyoto Protocol began in 2008 and major Annex I countries have introduced domestic or regional emission trading schemes to fulfill their reduction goals cost–efficiently and the typical case is EU's emission trading scheme. The USA and Australia did not ratify Kyoto Protocol and therefore are not regulated by the Kyoto System, but both countries are operating voluntary emission trading schemes within their regions, and additionally a number of voluntary emission trading schemes have been introduced and operated. Under such emission trading systems, the methods in which the forest sector participates

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* This Paper was supported by Sunchon National University Research Fund in 2011

in the project and the contents of forest related carbon offset standard are manifested in a variety of ways according to the characteristics of each emission trading scheme.

This study was conducted to compare and analyze how the forest sector participates in the emission trading schemes operated around the world to derive implications and to suggest how the forest sector can participate in the cap and trade system which will be introduced in full scale in Korea in the future.

MATERIALS AND METHODS

The type and characteristic of emission trading schemes currently implemented around the world, and how the forest sector is participating in each scheme, and the characteristic and trend of the emission trading market were analyzed based on related literatures and carbon offset standard. The major elements that constitute the standard such as the operating system and characteristic of the forest carbon offset project, type and scope of project, credit type, additionality, non–permanence, and monitoring and verification were compared and analyzed based on the carbon offset standard related with the forest sector under each scheme.

RESULTS AND DISCUSSIONS

Carbon Emission Trading Scheme and Participation of Forest Sector

Emission trading scheme (ETS) is the system which obligates the countries or companies that overachieved their reduction goal concerning the greenhouse gas emission limit and those who exceeded the their limits trade over and shorts and the participants of the system trade the emission reduction unit or certified emission reduction which is also referred to as the carbon credit or emission unit with each other. The emission trading scheme lets its participant choose the plan to cost–effectively reduce greenhouse gas emission to provide flexibility in observing the obligation to reduce greenhouse gas. One of political means for greenhouse gas emission reduction, carbon tax, controls greenhouse gas emission by varying price variable, the emission trading scheme has the advantage of managing the country's entire greenhouse gas emission by directly controlling greenhouse gas emission.

The emission trading schemes implemented around the world are divided by the type of participation into Regulated Emission Trading Scheme and Voluntary Emission Trading Scheme. Regulated emission trading scheme is the system where related sectors and companies are obligated to participate in order to achieve the reduction goal allocated by Kyoto Protocol, regulation, or law. Voluntary emission trading scheme is the system where companies, organizations, non–profit organizations, and individuals voluntarily participates in order to reduce greenhouse gas in the atmosphere to fulfill their social responsibilities and protect environment without any obligation imposed by Kyoto Protocol or laws and it is also divided into cap and trade system and voluntary emission trading scheme depending on whether the system has the reduction goal.

Regulated emission trading scheme offers offset baseline–and–credit program along with cap and trade system. Voluntary emission trading scheme offers offset standard without cap except Chicago Climate Exchange (CCX)'s CCX Offset Program.

Regulated Emission Trading Scheme

The typical emission trading scheme currently operated to fulfill the reduction obligation given by Kyoto Protocol is EU's Emission Trading Scheme (EU–ETS). EU–ETS is the cap and trade system introduced in January 2005 to fulfill the reduction goals set for each member of EU by Kyoto Protocol on the level of EU. Total 27 EU members are participating in the scheme with the goal to reduce greenhouse gas emission by 8% compared to the emission level measured in 1990.

The emission was initially allocated without cost considering past emission records and emission unit, and some of it can be distributed at a cost through auction. In addition to the AAU (Assigned Amount Unit) for each country based on Kyoto Protocol, the emission rights (ERU: Emissions Reduction Unit and CER: Certified Emissions Reduction) that are acquired through Kyoto

Table 1. Type of ETS

Participation Type	Cap–and–Trade Program	Associated Baseline–and–Credit (Offset) Program
Regulated ETS	ETS Under Kyoto Protocal	Clean Development Mechanism (CDM), Joint Implementation (JI)
	EU–ETS	CDM, JI
	RGGI (Regional Greenhouse Gas Initiative)	RGGI Offset Programme
Voluntary EST	CCX (Chicago Climate Exchange)	CCX Offset Program

Source: Kollmuss, A, H. Zink and C. Polycarp. 2008 *Making Sense of the Voluntary Carbon Market, A Comparison of Carbon Offset Standards*

Mechanism such as JI (Joint Implementation) and CDM (Clean Development Mechanism) are also traded. However, emission rights acquired from Land Use, Land–Use Change and Forestry (LULUCF) are not traded as LULUCF, forest sink project in particular, has unstable solutions for non–permanence and leakage and requires high administrative cost. In January 2008, EU Commission adopted the report on the improvement measures for EU–ETS and reconfirmed that the emission rights through forest sink project shall be excluded from trade for post–2012 periods (European Parliament and the Council of EU, 2004).

Apart from EU–ETS, New Zealand which is also included in Annex I of Kyoto Protocol is implementing cap and trade system (NZ–ETS). New Zealand introduced the cap and trade system starting with the forest sector in 2008 in accordance with the Climate Change Response Act established in 2002, and is planning to gradually expand the system to cover power and industry in 2010 and agriculture (occupies 50% of total emission) in 2013 and all sectors as of 2015. They are promoting the scheme of allocating emission rights to forest sector at no cost, to power sector 100% by auction, and to industry sector at no cost up to 90%. Not only the forest sector was directly included in NZ–ETS for the first time in the world but also the trading system was introduced to the forest sector for the first time in the world, and it is unlikely that this will take place elsewhere. The reason they introduced the emission trading scheme to the forest sector is to prevent current trend of deforestation and the system is operated with the goal to prevent deforestation and to expand sink through afforestation and reforestation. The forest land is divided into post–1989 forest land and pre–1990 forest land and the owners of each forest land are asked to participate in the system. Post–1989 forest land refers to the land which was not the forest land as of December 31, 1989 but converted into the forest land after December 31, 1989 through the plantation of foreign tree species and or the growth of aboriginal tree species. Post–1990 forest land refers to the land which has been forest land as of December 31, 1989 and is still forest land as of December 31, 2007 and is mainly composed of foreign tree species. Since 1989, the owners of forest land participated in the system voluntarily. The participant is given the emission rights named NZUs from the government for the increase of carbon sink to the forest due to the growth of his or her forest since January 1, 2008. However, if the forest's carbon sink capacity reduces due to logging, conversion of usage, and forest fire compared to the capacity reported previously, then he or she must return the emission rights to the government for the reduced capacity. To prevent the conversion of the usage of pre–1990 forest land, the government distributed the emission rights to forest land owners at no cost and retrieves the emission in case the usage is converted. A total of 55 million NZUs will be distributed, and approximately 38%, 21 million NZUs, will be given during the first commitment period between 2008 and 2012 and approximately 62%, 34 million NZUs, will be given after 2012 (Ministry for Environment, 2007; Ministry for Agriculture and Forestry, 2008).

The emission trading systems that take reduction obligation for the emission allocated in accordance with mandatory control but not regulated by the Kyoto System due to the rejection of the ratification of Kyoto Protocol are RGGI (Regional Greenhouse Gas Initiative) of the USA and NSW (New South Wales) of Australia. RGGI is the emission trading system that 10 northeastern states and central Atlantic states of the USA established and began to implement as of January 2009. Through RGGI, 10 northeastern states of the USA set emission cap for thermal power plants with the capacity equaling or exceeding 25MW to trade emission rights, and they obligated the reduction of emission from the level in 2009 by 10% as of 2019 and introduced a variety of emission reduction methods. All emission rights are distributed at a cost, but the carbon offset project is used as an emission reducing measure. In other words, the sectors that received emission rights other than power plants are encouraged to generate carbon offset credits from greenhouse gas reduction project and use them to achieve their goals. The carbon offset projects here include the collection and destruction of methane from landfill sites, reduction of the sulfur hexafluoride emission from power plants, carbon fixation through afforestation, reduction or evasion of carbon dioxide through the improvement of the building's energy efficiency, and the reduction of methane discharge through the management of farm land (Regional Greenhouse Gas Initiative, 2008).

NSW has been implemented from 2003 to reduce greenhouse gas emission in the power generation sector in the New South Wales State of Australia, and their goal is to reduce greenhouse gas emission by 5% from the level measured in 1990. Power suppliers in NSW area are obligated to participate in the system and are given the emission cap and large power consumers can voluntarily participate in the system to receive emission cap. In NSW, the participant under market regulation can purchase and use the Greenhouse Gas Abatement Certificates or Renewable Energy Certificate that are approved and issued for low–emission power generation, enhanced power generation efficiency, and power consumption reduction (demand management) and carbon sink project to observe emission cap, and the forest sink projects such as afforestation and reforestation are recognized as one of carbon sink project for producing Greenhouse Gas Abatement Certificates (The Greenhouse Gas Reduction Scheme, 2010).

Voluntary Emission Trading Scheme

Voluntary emission trading scheme is the general term for the system where participants voluntarily conclude a treaty on the reduction commitment and obligatorily reduce greenhouse gas emission through the trade within the market and the system where participants join the greenhouse gas reduction and offset projects voluntarily solely to cope with climate change. The typical example of the former is CCX (Chicago Climate Exchange) of the USA and that of the latter is J–VER

(Japan Verified Emission Reduction) of Japan.

Unlike EU–ETS, CCX which began in 2003 is the cap and trade system where participants and member companies join the system at their will, however are given legal obligations once they join the system. The members of the system have the goal of reducing 6% from the minimum baseline which is the annual average greenhouse gas emission between 1998 and 2001 as of 2010. The emission cap is determined for each participant under this goal, and the participant can transfer or sell emission rights for additional reduction or must fulfill the goal by purchasing the emission rights for the exceeding amount. CCX introduced the idea of carbon offset project, registers worldwide reduction performance through their own verification procedure, and have members purchase the emission rights to fulfill their goals. Carbon offset project is a greenhouse gas reduction activity similar to CDM project. The carbon offset project must be the greenhouse gas reduction activity promoted by a business entity who is not a member of CCX who manages its own emission according to CCX's emission reduction plan. Agricultural methane reduction, coal mine methane reduction, landfill methane reduction, agricultural soil carbon fixation, grassland soil carbon control, forest sink, renewable energy development, and ozone depletion material elimination project are acknowledged as carbon offset projects.

In May 2005, Japanese government introduced Japan's first voluntary cap and trade system, J–VETS (Japan's Voluntary Emissions Trading Scheme), to accumulate data and knowledge about emission trading system and encourage companies to participate in the system before fully introducing regulated emission trading scheme. Later on in October 2008, Japan introduced another voluntary emission trading system, J–VER (Japan Verified Emission Reduction), to guarantee certain level of quality and issue domestic credit tradable in the market through independent efforts of individuals, companies, and local governments to reduce greenhouse gas emission and increase absorption. To induce corporate participation, Japanese government is providing incentives such as the subsidy, low interest loan, and the establishment of emission rights registry to those who fulfilled the reduction goal and imposing minimum restrictions such as retrieving subsidy on those who failed to achieve the reduction goal. Also, the use of emission rights that are issued based on systems that have legal binding force including Kyoto Protocol such as CER and ERU is permitted along with the use of J–VER which is verified through domestic carbon offset project in order to help companies achieve the reduction goal easily and cope with regulated market in the future. Forest sector's projects covered by J–VER include afforestation, reforestation, forest management, wood biomass and various other projects (Certification Center on Climate Change, Japan, 2010).

Emission Trading Market Trend

Carbon market is the market where greenhouse gas is traded and greenhouse gas emission rights are traded

Table 2. Characteristics of Major Emission Trading Scheme

Type of Participation			Start Year	Subject	Goal	Participation of Forest Sector
Regulated	Kyoto	EU–ETS	2005	EU 27 Members Industry Sector	10% Reduction as of 2010 from 1998~2001 Average	Unrecognized
		NZ–ETS	2008	NZ Forest Sector	Prevention of Deforestation and Expansion of Forest Sink	Cap and Trade (Afforestation, Deforestation)
	Regulation/ Law	RGGI	2009	10 Northeastern States of America Power Plant	10% Reduction from 2009 until 2018	Carbon Offset Project (Afforestation)
		NSW	2003	NSW Area Power Supplier	5% Reduction of Greenhouse Gas from the Level of 1990	Carbon Offset Project (Afforestation / Reforestation)
Voluntar	Cap and Trade	CCX	2003	Local Government, University, Private Company	6% Reduction as of 2010 from Annual Average between 1998~2001	Carbon Offset Project (IPCC Specified Forest Project)
	Voluntary Participation	J–VER	2008	Private Company, Individual, Group, etc.	Voluntary Reduction	Carbon Offset Project (Afforestation, Forest Management, Wood Biomass)

Table 3. Transaction Volumes and Value, Global Carbon Market

Markets	Volume ($MtCO_2e$)		Value (million US$)	
	2007	2008	2007	2008
Voluntary OTC	43.1	54.0	262.9	396.7
CCX	22.9	69.2	72.4	306.7
Other exchanges	0	0.2	0	1.3
Total Voluntary Markets	**66.0**	**123.4**	**335.3**	**704.8**
EU ETS	2,061	2,952.0	50,097.0	94,971.7
Primary CDM	551.0	400.3	7,426.0	6,118.2
Secondary CDM	240.0	662.4	5,451.0	15,584.5
Joint Implementation (JI)	41.0	8.0	499.0	2,339.8
Kyoto (AAU)	0.0	16.0	0.0	177.1
New South Wales	25.0	30.6	224.0	151.9
RGGI	–	27.4	–	108.9
Alberta's SGER	1.5	3.3	13.7	31.3
Total Regulated Markets	**2,919.5**	**4,090.0**	**63,710.7**	**119,483.4**
Total Global Markers	**2,985.5**	**4,213.5**	**64,046.0**	**120,188.2**

Source: Ecosystem Marketplace, New Carbon Finance. 2009 *State of the Voluntary Carbon Markets 2009*

Table 4. Trade Volume and Value in Forest Carbon Market

Markets	Volume ($MtCO_2e$)		Value (million US$)	
	Previous Total	2008	Previous Total	2008
Voluntary OTC	15.3	3.7	129.7	31.5
CCX	2.6	1.3	7.9	5.3
Total Voluntary Markets	**17.9**	**5.0**	**137.6**	**36.8**
New South Wales	1.8	0.2		–
A/R CDM	0.5	0.1	2.9	0.3
NZ ETS	0.1	–	0.7	
Kyoto (AAU)	0.6	–	8.0	–
Total Regulated Markets	**2.9**	**0.2**	**11.6**	**0.3**
Total Global Markers	**20.8**	**5.3**	**149.2**	**37.1**

Source: Ecosystem Marketplace. *2010 State of the Forest Carbon Markets 2009*

directly or through brokers in the form of spots or futures (Yim, 2008). The carbon market was formed as Kyoto Mechanism from Kyoto Protocol or the flexible mechanism such as Clean Development Mechanism (CDM), Joint Implementation (JI), and Emissions Trading System (ETS) was introduced to minimize the reduction cost in fulfilling greenhouse gas reduction obligation.

The scale of the world's emission trading market is estimated at 4,214 million tCO_2 in trade volume as of 2008 which is approximately 1.4 times the trade volume of 2007 which is 2,986 million tCO_2. In the trade amount, the market is estimated at 120.2 billion dollars as of 2008 which is approximately twice larger than 64 billion dollars in 2007, showing the expansion of trade scale (Ecosystem Marketplace and New Carbon Finance, 2009). The scale of regulated emission trading market is estimated at 4,090 million tCO_2 or 119.5 billion dollars as of 2008 taking up to 97.0% of the market share in trade volume and 99.4% in trade amount that its scale is overwhelming in the world's emission trading market. On the contrary, the scale of the voluntary emission trading market was estimated at 123 million tCO_2 or 700 million dollars as of 2008 taking only 3.0% of market share in trade volume and 0.6% in trade amount. In other words, the scale of the voluntary emission trading market is very small compared with the regulated market, however, is continuously increasing.

Forest sector in the world's carbon emission trading market is estimated at approximately 5.3 million tCO_2 in trade volume and 37.1 million dollars in trade amount as of 2008. In the regulated emission trading market which includes EU–ETS, the forest section takes less than 0.1% share which is quite small (World Bank, 2009). However, the scale of voluntary market was estimated at approximately 5.0 million tCO_2 in trade volume and 36.8 million dollars in trade amount that the trade scale was rela-

tively large than the regulated market. In particular, the voluntary OTC (Over The Counter) trade took very large share compared with other emission trading markets, and this is because participants have more flexibility with the voluntary market than the regulated market and the greenhouse gas reduction through the development of various forms of forest carbon offset standards in the voluntary market has been approved (Ecosystem Marketplace, 2010).

Comparison and Analysis of Forest Carbon Offset Standards

The carbon offset standards can be divided into five categories; Full–Pledged Standards, Project Design Standard (PDS), Offset Standard Screens, Offset Accounting Protocol, and other standards (Kollmuss, A, H. Zink and C. Polycarp, 2008). The full–pledged standards or the "standard" standard has three elements; account standard, monitoring, verification and authentication standard, and registration and enforcement system. Project design standard has account standard, monitoring standard, and guideline, but none related with authentication or registration. In other words, it has to be used with the full–pledged standard in order to authenticate or register the credits produced. Offset standard screens is not a complete standard, and it approves the project conducted based on another standard but holds fast to its own standard for monitoring. Offset accounting protocol contains the procedure and definition for accounting greenhouse gas reduction from offset project but none about related managing agent. It contains feasibility review, and regulation and procedure of specific programs for registration and verification/authentication, but it does not define appropriate standards and procedural conditions, and many standards are based on this type of protocols. There are standards that do not fall under these categories, but they are not used widely. As discussed, the operating agent of offset standards related with forest among offset standards in various categories and their major elements were compared and examined.

Forest carbon offset standard is generally divided into the one that is based on voluntary emission trading scheme (Climate, Community & Biodiversity: CCBS, Voluntary Carbon Standard: VCS, Carbon Fix Standard: CFS, Plan vivo, J–VER, Greenhouse Friendly, Chicago Climate Exchange: CCX) and the one that based on regulated emission trading scheme (Regional Greenhouse Gas Initiative: RGGI, Climate Action Reserve: CAR) and is related with national and local laws. The former calculates carbon dioxide absorption based on standard or protocol concerning various forest projects with limitation for afforestation CDM project such as afforestation, forest management, the prevention of deforestation, and wood product carbon fixation and issues credit through monitoring and third party verification. This type of standard was developed to issue standardized credits which assure certain level of quality and trade emission rights in voluntary emission trading markets (OTC). The latter is designed to produce high quality carbon offset credits based on relatively strict standard or protocol as the agent to which the emission target is allocated purchases the credit to achieve reduction goal cost–efficiently.

Operation System

The operating organization for carbon offset standard using forest under regulated emission trading scheme is comprised of government, local government, or certification and verification agency they designated except for CCX. The government organizes legal system such as the operation system and guidelines of the program and also designates and manages certification agencies. The certification agency is the public or private agency that represents the government to take responsibilities for overall program operations such as the operation of certification committee and issue of carbon offset credit. For voluntary scheme, the central or local government does not take part in the scheme but a variety of experts and interested parties participate centering on private organization such as associations and foundations to develop standards and operate the program. In this case, the board of directors of a private organization or professional committee reviews the carbon offset project and issues credit based on the verification report.

Major Elements of Forest Offset Standard
Subject and Scope of Project

Forest carbon offset project under emission trading scheme targets various type s of projects such as afforestation, reforestation, forest management, the preven-

Table 5. Offset Standard Type

Full–Fledged Standards	Project Design Standard	Offset Standard Screens	Offset Accounting Protocol	Other
CDM VER+ CCX If registries are established, Gold Standard (GS) Voluntary Carbon Standard(VCS)	Climate, Community & Biodiversity Standards (CCBS)	Voluntary Offset Standard(VOS)	ISO 14064–2 WRR/WBCSD's GHG Project Protocol CAR's Offset Project Protocols	Plan Vivo

tion of deforestation as well as the recovery of vegetation, wood product carbon fixation, and so forth. RGGI, CAR, J–VER, and Greenhouse Friendly only targets the projects conducted within the region or country whereas CCX does not have limitation on the location of project in principle. However, it limits project registration with EU in order to prevent duplicate accounting of the credit. Plan vivo only targets the project in developing nations based on the basic principle of the standard.

Credit Issue Period and Method

The credit issue period of forest carbon offset project is set to 10 years to be the minimum, 20 years, and 100 to be the maximum. CCX issues credits for 8 years which is the effective period of the program itself, J–VER issues credits between 2008~2012 which is the first commitment period of Kyoto Protocol. Greenhouse Friendly requires participants to apply for the re–approval of the project every 5 years.

The credit issue method is divided into pre–issue and post–issue. Pre–issue estimates the carbon fixation during a certain period of time in the future and issues credit before executing and monitoring the project when registering the project. This is advantageous for securing fund for executing and maintaining the project but involves great uncertainty that the value of the credit is relatively underestimated. On the other hand, the post–issue issues credit after the project is executed, monitored, and verified. This system estimates the carbon absorbed during a fixed period (usually 3~5 years) after monitoring and verification that it involves low risk and produces relative high quality credit. Accept CFS and Plan Vivo, most projects take post–issue system which issues credit after the project is executed, monitored, and verified.

Additionality

Additionality is the standard which represents that additional greenhouse gas reduction compared to the baseline would not have happened if corresponding project was not executed and it is the key element for the connection between forest sink project and emission trading scheme. Project–oriented and performance–oriented additionality analyses are conducted to prove additionality and the degree and procedure vary depending on forest carbon offset standard.

The project–oriented additionality evaluation assesses the additionality in the aspect of law, finance, barrier, and custom of each project similarly to the afforestation CDM project of Kyoto Protocol. Regulatoy additionality analysis is the simplest way of assessing additionality. Only the project–oriented reduction not required laws and regulations is evaluated as additional project. However, many forest carbon offset projects allow various voluntary actions related with common market practices to obtain credits or the practices leading to high economic efficiency. In other words, it is necessary to conduct regulatory additionality analysis as well as the additionality analysis in other aspects. Financial additionality analysis examines the economic efficiency of the project when there is no income from credit sales. If the economic feasibility of the project is rated low when there is no credit for forest carbon offset, the project is considered to have additionality.

Performance–oriented additionality evaluation partially complements the weakness of the additionality evaluation by project and the advantage of this is that less burden is given to the operator since the system operating agent shoulders the expense and the additionality can be evaluated more objectively. However, it requires extensive time and expenses such as comprehensive data collection and verification and periodic update to set performance standard for additional project and it is not appropriate for certain industrial sectors.

The performance–oriented additionality evaluation is divided into positive list and performance standard. The positive list defines and lists the type of additional project that does not possibly take place in common market practice and qualitative eligibility standard, technology, and location. Performance standard sets quantitative benchmark standards (that do not possibly take place in common market practice) such as emission speed, energy efficiency, and market coverage by project category and considers the project that exceeds these standards as additional project.

In the forest carbon offset standard, VCS or CFS conducts strict additionality analysis based on afforestation CDM by each project to evaluate the additionality while CCX and so forth takes relatively mild additionality standard. RGGI and CAR are regulated emission trading schemes that they conduct regulated additionality analysis as well as performance–oriented analysis. Japan's J–VER suggests the project list which is considered to have additionality and the eligibility standard which includes regulated additionality.

CO_2 Sink and Calculation of Absorption Amount

For the subject for the calculation of CO_2 absorption, non–wood biomass and wood project carbon are obligatorily considered for some forest project types for CFS, RGGI, and CAR. Japan's J–VER only considers the wood biomass that exists on the ground and underground.

For the calculation of baseline and CO_2 absorption, the carbon stock within the project's perimeter in the beginning of the project is taken as the baseline for CFS, CCX, and J–VER. RGGI takes average carbon stock for 1 year before the beginning of the project as the baseline. VCS, CAR, and Greenhouse Friendly determines the baseline by forecasting Business As Usual (BAU) scenario.

Non–Permanence Management

The issue of non–permanence is the largest disadvantage of the forest carbon offset project and the reason forest sink project is excluded from the regulated emission trading scheme, EU–ETS, and AR CDM project is not largely activated compared with other project types. In case project's perimeter is limited by forest, the forest carbon stock can be reduced by natural disturbance (forest fire, harmful insect, etc.) or artificial disturbance (deforestation, logging, etc.) within or after the credit

issue period, and this is called non–permanence. Forest carbon offset standards uses various measures to cope with the non–permanence of forest project to secure the permanence of forest sink credit.

The voluntary scheme establishes the plan to evaluate and relieve project risks in the process of designing the project and compensates the risk with the buffer credit which was deposited previously or with reforestation. The allocation of buffer credit for each project is set to at least 5~10% of the result of project risk evaluation and at most 60%. The regulated scheme has more strict and substantial forest preservation mechanism than the voluntary scheme. In other words, it obligations the preservation of forest for a fixed period of time on the condition of regional preservation right with legal binding force, limit of action, forest preservation contract or pledge and compensates risks with the allocation of buffer credit and reforestation like the voluntary scheme and the purchase of credits. Also, California's CAR obligates project developers to compensate risk with ordinary credit instead of buffer credit in case forest carbon is lost due to artificial and avoidable causes such as harvest and land development in order to intensify the responsibilities of project developers.

Monitoring and Verification

Forest carbon offset project undergoes third party verification procedure where an independent agency conducts monitoring and verification. Verification period is commonly 5 years. For CAR, the monitoring is conducted every year and the verification including the visit to the site is conducted every 6 years. CCX conducts monitoring through document review every year and conducts verification selectively. The verification procedure is comprised of document review and site inspection, and the subject and frequency of site inspection follows

Table 6. Comparison of Forest Carbon Sink Standards in Major Emission Trading Schemes

Division	Standard / Program	Purpose	Year	Operator	Project Type	Location	Additionality
Voluntary	CCBS	Voluntary Carbon Offset, Carbon Market Participation, Etc.	2005	CCB Alliance	Afforestation, Forest Management, Prevent Deforestation, Farm Land, Soil	No Limit	Project–Based
	VCS		2007	VCS Alliance	Afforestation, Forest Management, Prevent Deforestation, Farm Land, Wood Product, Soil	No Limit	Project–Based, Performance –Based
	CFS		2007	CFS Alliance	Afforestation, Forest Management	No Limit	Project–Based
	Plan Vivo		1994	Plan Vivo Foundation	Afforestation, Forest Management, Prevent Deforestation, Farm Land, Soil	No Limit	Project–Based
	J–VER		2008	Climate Change Response Certification Center	Afforestation, Forest Management	Japan	Performance –Based
	Greenhouse Friendly		2005	Snowy mountain engineering Corp.	Afforestation, Forest Management	Australia	Project–Based
	CCX		2003	Carbon Offset CCX Committee	Afforestation, Forest Management, Prevent Deforestation, Urban Forest, Wood Product	Exclude Europe	Project–Based
Regulated	RGGI	Fulfill Regulated Goal	2009	State Government	Afforestation	USA	Project–Based, Performance –Based
	CAR		2001	CAR Board of Directors	Afforestation, Forest Management, Prevent Deforestation, Urban Forest,	USA	Project–Based, Performance –Based

Table 6. Comparison of Forest Carbon Sink Standards in Major Emission Trading Schemes

<Continued>

Division	Standard / Program	Absorption Scope	Non –Permanence	Monitoring	Verification Agency	Credit Type	Trade Type
Voluntary	CCBS	Above and Underground Wood Biomass is Mandatory, Dead Tree, Non–Wood Biomass, Soil can be Selectively Included (Considering Discharge and Leakage due to Project)	Risk Assessment, Relief Plan, Buffer (10%)	5 Years	CDM DOE, ISO 14065 Certified Agency, FSC Certified Agency, Other Certified Agencies	None	Market Tradable (Registry)
	VCS		Risk Assessment, Relief Plan, Buffer (5–60%)	5 Years		Post–Issue (20–100 Years)	
	CFS		Risk Assessment, Relief Plan, Buffer (30%)	0 Years after Registration, 2 Years, Every 5 Years Afterwards		Pre–Issue (30 Years–)	
	Plan vivo		Risk Assessment, Relief Plan, Buffer (10–60%)	Monitoring for 1 Year, Verification is Recommended		Pre/Post–Issue (5–15 Years)	
	J–VER		Pledge, Reforestation, Buffer (3%)	5 Years		Post–Issue (5 Years)	
	Greenhouse Friendly		Management Plan, Forest Preservation (70 Years) Proof, Reforestation, Buffer, Indicate Ownership	5 Years		Post–Issue (5 Years)	
	CCX		Forest Preservation (15 Years) Pledge, Buffer (20%)	Document Review for 1 Year, Verification when Recommended by Board of Directors	CCX Committee Approved Agency	Post–Issue (8 Years)	
Regulated	RGGI		Preservation Region, Buffer (10%)	5 Years	State Government Approved Agency	Post–Issue (–60 Years)	
	CAR		Preservation Region, Limit of Action, No Contract for Carbon Loss Compensation, Buffer, Cancellation of Project	Monitoring for 1 Year, Verification for 6 Years	ISO 14065 Certified Agency, CAR Certified Agency	Post–Issue (100 Years)	

program regulation or board of directors' advice. CCX recommends the site inspection for 10% of the registered locations.

For verification agency, choose the agency with expertise in the corresponding field or international recognition (CDM DOE, ISO, FSC certified agencies, etc.). VCS takes dual verification procedure carried out by two verification agencies designated by the operator and VSC board of directors for the objectivity of verification and fairness. VCS and CFS acknowledges 1–person verification agency for small projects. J–VER developed efficient verification system through the cooperation with local experts and private organizations.

CONCLUSION

Korea's greenhouse gas reduction goal is confirmed as 30% of BAU of 2020 and the "Framework Act on Low Carbon, Green Growth" passed the legislative proceedings of the National Assembly and was effectuated from April 14, 2010. The Framework Act on Low Carbon, Green Growth provides the legal basis for the introduction of cap and trade system (Article 46) through which Korea can fulfill domestic greenhouse gas reduction goal cost–effectively using the market function. Korea will establish reduction goal for each sector and push forward with the goal management system for each company managed and also opened the door to the participation of the forest sector by including greenhouse gas

reduction/absorption/elimination performance as the means to fulfill the reduction goal by companies managed.

Currently, advanced nations have introduced and have been implementing regulated emission trading schemes in which related sectors and companies are obligated to participate in order to efficiently fulfill the greenhouse gas reduction obligation allocated in accordance with Kyoto Protocol or regulations and laws. Also, voluntary emission trading scheme is not related with Kyoto Protocol or regulations and laws but is being implemented by companies, organizations, and individuals willing to reduce greenhouse gas. Such emission trading schemes created carbon credit in the forest sector, however, is not traded in EU–ETS which is the typical emission trading market due to the problems of non–permanence, additionality, and leakage. However, most emission trading schemes other than EU–ETS developed flexible and a variety of forest carbon offset standards for forest sector to participate in the forest carbon offset projects to be used as the means to fulfill greenhouse gas reduction. The subject of forest carbon offset project is also contributing to cost–efficient reduction by greenhouse gas reducing agents including enhanced forest management, prevention of deforestation, recovery of vegetation, wood product carbon account, and so on in addition to afforestation and reforestation by resolving the problems of non–permanence through reforestation, buffer credit allocation, forest preservation pledge, and so forth. Considering such worldwide operations, it is recommended that the forest sector participate in the cap and trade system that Korea will introduce in full scale in the future through carbon offset projects for it can prove the forest's greenhouse gas skinning capacity and induce sustainable forest management.

For the forest sector to participate in the domestic emission trading scheme through carbon offset project to produce quality carbon credits, it is necessary to develop forest carbon offset standard which defines the project activity, geographical scope of the project, carbon absorption estimation method, additionality, non–permanence, and monitoring and verification method in advance. It is also necessary to establish the operation system for carbon offset project and develop guidelines for the main agent of operation. Also, it is necessary to seek for the way to find ties with existing related systems in order to establish connection between forest offset project and national emission trading scheme. Lastly, it is necessary to enhance forest carbon offset standards and operation system on a continuous basis through step–by–step operation to secure the reliability and transparency of forest carbon offset project and accumulate experience and knowledge.

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