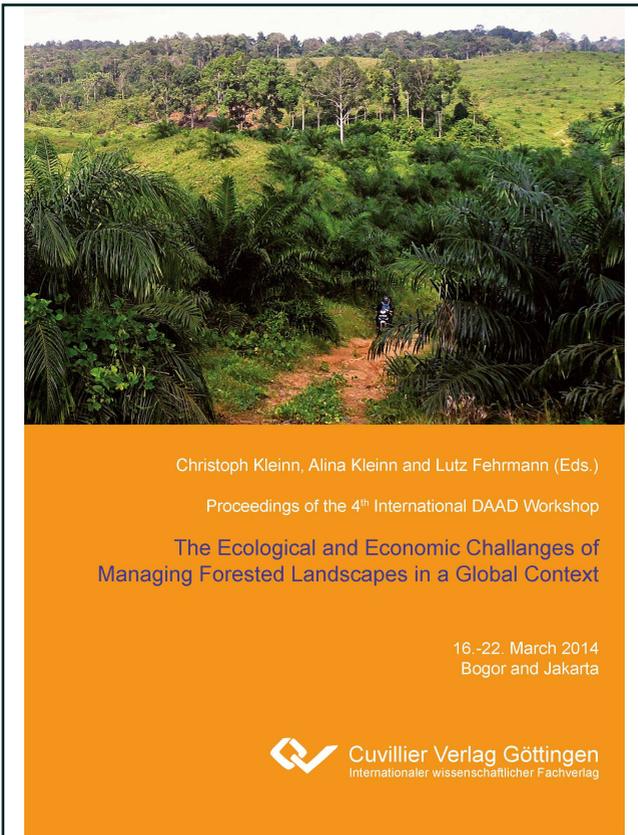Lutz Fehrmann (Herausgeber)
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The Ecological and Economic Challenges of Managing Forested Landscapes in a Global Context

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Chapter One

Carbon

An overview of carbon forestry in China

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Abstract

Climate change is the greatest challenge facing the world today. While China is among the top countries for global greenhouse gas emissions, it is also among the countries most vulnerable to climate change. The fight against climate change is a top priority in China. The forests in China have huge potential for carbon sequestration and can play a significant role in mitigating climate change by implementing carbon forestry. This article provides an overview of carbon forestry in China, ranging from climate policies and actions to challenges facing carbon forestry. It is concluded that China has an enormous potential and favorable national circumstances to benefit from carbon forestry implementation. However, a variety of challenges need to be addressed in a comprehensive context.

1.   Background

Climate change is an unprecedented long-term global challenge that threatens the sustainable development of each country and the world as a whole. All countries and people of all ages in the highly globalized world of today are suffering from it. The main cause for it is believed to be the increase of emissions of carbon dioxide and other greenhouse gases (GHGs) into the atmosphere. There is evidence that human activities have contributed substantially to that increase, primarily by the burning of fossil fuels. But it is certain that climate friendly human activities can mitigate climate change. Climate change can only be addressed effectively through global efforts before its adverse impacts are fully realized and turn out to be unmanageable. It is urgent and vital for all countries, both developed and developing, to formulate national strategies, policies and action plans on climate change on a global basis and to make them work on the ground in order to reach the global climate change targets.

China is a signatory of the United Nations Framework Convention on Climate Change (UNFCCC) as a non-annex I country since 1992 and ratified the Kyoto Protocol in 1998 without mandatory targets to reduce its emission of GHGs. The rapid economic growth in China over the past decades followed a drastic increase in carbon emissions and put China among the largest emitters in the world. In 2006, China accounted for one quarter of the global annual carbon emissions and overtook the United States to become the largest annual emitter of carbon dioxide (CO_2) in the world. In 2008, two thirds of the total global increase in carbon emissions came from China alone. China remains the number one carbon emitter with

its share increasing to 22.95% of global annual emission in 2013, despite a significant drop of carbon intensity (CO_2 emissions per unit of GDP) over the past years (Harris, 2010). The large emissions in China are incurred mainly by the burning of coal in the coal-fired power sector, followed by fossil fuel combustion. However, China's average per capita carbon emission is relatively low, just slightly above the global average and far below those of the developed countries. In addition, China's cumulative historical carbon emissions are around one-fourth of those of the United States, the largest historical carbon emitter.

China is also among the countries most vulnerable to climate change, mainly in the field of agriculture, livestock breeding, forestry, natural ecosystems, water resources and coastal zones. The major climate threats to China are floods, storms and coastal hazards (State Council, 2008; The World Bank, 2009). The adverse impacts of climate change on China are huge and complex but discernible, and have become a serious public concern. Various studies show that climate change in China tends to become stronger and have more serious consequences. In China, climate change turned from a purely scientific issue in academia in 1980s to a strategic developmental and highly politicalized issue nowadays, together with other environmental problems such as frequent smog. The central government of China has realized that China's previous high-carbon development paradigm is not sustainable any longer, and the environmental issues arising during the period of rapid economic growth such as climate change, demand to be urgently addressed not only for maintaining economic growth, but also for political stability in China. China has to commit itself to combating climate change and a paradigm shift towards green low-carbon economy, even if it is only for its self-interest of sustainable development, including a reduction of its high climate change vulnerability.

China has attached top priority to climate change and formulated China's National Climate Change Program (CNCCP) in accordance with the provisions of the UNFCCC and its national circumstances in 2007. The following six guiding principles for climate change combat are defined in CNCCP (NDRC, 2007; State Council, 2008):

- Address climate change within the broader framework of the country's "national sustainable development strategy"
- Lay equal stress on both climate change mitigation and adaptation
- Integrate climate change policies with other interrelated policies
- Rely on technology for effectively mitigating and adapting to climate change
- Follow the principle of "common but differentiated responsibilities", and
- Actively and extensively participate in international cooperation on climate change

The policies and Actions in the CNCCP are then translated into China's national overall development plan and the 12th Five-Year-Plan (2011-2015). In the meantime, China makes continuous efforts to implement those policies and actions in the entire country by all means. Annual progresses in implementation of the climate change policies and actions are monitored and assessed by entrusted domestic institutions for policy evaluation and modification to en-

sure achievement of defined objectives. The monitoring results are then published in an annual report, entitled China's Policies and Actions for Addressing Climate Change, by the National Development and Reform Committee (NDRC), the supreme authority in charge of climate change issues in China. The published reports show that China's policies and actions on climate change have had good effects and China has made considerable progresses, although China still has the largest share of global carbon emission increase. It is noted in the annual report 2013 that China's carbon intensity continued to decrease by 5.02% of 2012 level.

As the current global carbon emission champion, China is widely recognized as a vital partner for climate change mitigation and is receiving strong demands and even pushes from the world, mostly the largest historic emitters, to take on more responsibilities for global carbon emission reduction. Owing to domestic and international factors and the confidence gained from the climate change addressing capacity built in the past, China pledged its voluntary national emission targets by 2020 at the United Nations Climate Change Summit in 2009, which are listed as follows:

- Reduce carbon intensity by 40% to 45% of 2005 levels
- Increase the share of non-fossil fuels to 15%
- Plant 40 million ha of forests and increase forest stock volume by 1.3 billion m^3 with reference to 2005 levels

China's climate change policies, efforts and performance in combating climate change remain to be debated. Whatever the outcome of such debate however, it seems without doubt that China will not derail from combating climate change and will continue to take on the responsibilities it can afford under its national circumstance for climate change. The reason is that the existing and impending impacts together with other environmental problems are interpreted by many Chinese people as an existential threat that has to be addressed urgently. But the strategies and policies on climate change in China may differ from those of the other countries and cause heated controversy.

2.   Role and potential of China's forests in climate change mitigation

Forests in China not only provide a variety of goods and services essential for people as in many other countries in the world, but also play an important role as either carbon sinks or carbon sources. It is evidenced that China's forests are vulnerable to adverse impacts of climate change (Stone, 2009). In 2008, the ice storm in southern China destroyed 18 million ha of forests, mainly plantation forests, in just a few days. Forests are complex ecosystems and climate change involves uncertainties of many sorts, it is therefore fairly challenging to manage forests in a sustainable manner under a changing climate. However, prudent forest management would considerably increase the forests' adaptability to climate change and enhance their role as carbon sinks.

In addition, existing evidences indicate that forest-based approaches to climate change mitigation are in general more cost-effective than others (Valatin and Price, 2014).

China has made continuous efforts in large scale afforestation, reforestation and forest protection, especially over the recent decades. The data from the 7th national forest inventory (NFI) of China show: forest cover in China, which was 8.5% in 1949 and 18.2% in 2007, has reached 20.36% (amounting to 2/3 of the global average); the average standing volume of Chinese forests was estimated to be 85.88m^3/ha, which is just 78% of the global average (SFA, 2009a) and that of the plantations was only 49.01m^3/ha. The forest carbon stock in China amounted to 7.8 billion tons. The data from the 8th NFI between 2009 and 2013 show that: forest area in China expanded to 208 million ha, including 122 million ha of natural forests and 69 million ha of plantation forests; the forest cover has reached 21.63%; and the total forest stock volume increased continuously to 15.137 billion m^3. The area of China's forests and that of plantation forests rank 5th and 1st in the world respectively.

These NFI data indicate that China's forests contributed significantly to climate change mitigation in the past and have still enormous potential for carbon sequestration in order to mitigate climate change in the future. It is exactly this historical contribution, significant potential and high cost-effectiveness of forests for climate change mitigation that makes China assign a top strategic priority to forestry for meeting its national climate targets. The State Forestry Administration (SFA) of China published a "Forestry Action Plan on Climate Change" (FAPCC) (SFA, 2009b) based on the national climate targets. The plan is divided into 3 phases, and the binding objectives for each phase are shown in Table 1.

Table 1. Phases and phase-objectives of FAPCC.

Phases	Forest cover	Forest stock volume
1 (by 2010)	20%	13.2 billion m^3
2 (2011-2020)	23%	14 billion m^3
3 (2021-2050)	26%	*(no data available)*

Two central pathways have to be followed in order to achieve the objectives in Table 1. One is expanding forest area by afforestation and reforestation to increase forest cover, and the other is improving the management of existing forests to increase forest stock volume.

Figure 1 shows that China still has a large area of shrubland and "forest preferable land" available for afforestation and reforestation to expand forest area. "Forest preferable land" refers to the land designated by a government at or above county level to be used for forests because forest rather than agriculture is a preferable land use for it. Afforestation and reforestation are eligible activities for the clean development mechanism (CDM). Financial and technical support for these activities can be obtained by developing CDM projects.
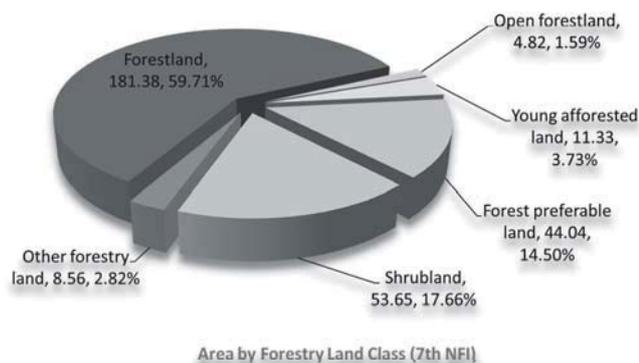
Open forestland,
4.82, 1.59%

Forestland,
181.38, 59.71%

Young afforested
land, 11.33,
3.73%

Forest preferable
land, 44.04,
14.50%

Other forestry
land, 8.56, 2.82%

Shrubland,
53.65, 17.66%

Area by Forestry Land Class (7th NFI)

Figure 1. Areas of forestry land classes in the 7th NFI (unit: million ha).

In a sharp contrast to the huge forest area, the forest standing volume per ha is very low, which also means a low carbon stock resulting from a low carbon sequestration capacity. It is believed that the carbon sequestration capacity of the existing forests, especially the young and middle-aged plantation forests, can be significantly enhanced by improving forest management. Forest management improvement is among the eligible activities of REDD+, which implies that the REDD+ mechanism can thus be utilized for financial support.

3. Implemented measures and actions for carbon forestry

In pursuit of forest cover increase, the forestry sector is continuing to promote nationwide voluntary tree-planting campaigns and to implement the following key forestry programs (Zhang, 2008):

- The shelterbelt development in Three-North, Yangtze River Basin and other regions
- The natural forest protection program (NFPP)
- Grain for green program (conversion of sloping cropland to forestland)
- The sandification control in the vicinity of Beijing and Tianjin
- The Wildlife Conservation and Nature Reserves Development Program
- The fast-growing and high-yield timber plantations base development program

In order to improve forest management, the State Forestry Administration has taken a series of measures and actions in recent years as follows: carried out the nationwide forest tenure reform from 2008 to 2013, extended forest tending subsidies from the pilot regions to the entire country, built 15 forest management model bases, and launched a pilot program for sustainable management in 200 towns, mainly forest farms, taking lumbering as the focus of the management.

A forest carbon monitoring system is essential not only for the monitoring of national carbon stock dynamics, but also for measurement, reporting and verification (MRV) of activities in the framework of REDD+. The State Forestry Administration first conducted the establishment of a forest carbon monitoring system in 17 pilot provinces and cities by 2009 and then across the country in 2013.

Carbon markets, both compliant and voluntary, can provide an additional source of revenue to support forest-based solutions to climate change. China has planned to establish a national carbon market to meet its climate targets. In 2008, three emission trading exchanges were set up in three municipalities: Beijing, Shanghai and Tianjin. In 2011, NDRC selected 5 cities (Beijing, Tianjin, Chongqing, Shanghai and Shenzhen) and 2 provinces (Hubei and Guangdong) as shown in figure 2 for carbon trading pilots. The carbon trading in Shenzhen, Shanghai and Guangdong was put into operation in 2013, and the rest will start in 2014. This carbon pilot program will serve as cornerstones for the establishment of a national-level unified emissions trading market between 2016 and 2020.

Figure 2. Map of approved carbon trading schemes in China (from IETA, 2013).

Standards and methodologies for carbon inventory and monitoring are required for the access of forest carbon into carbon markets. In 2009, the first voluntary carbon standard designed specifically for China, referred to as Panda Standard, was introduced. In 2005, the methodology for reforestation of degraded land, which was developed for the project of watershed management in Guangxi Province under clean mechanism (CDM), was approved by the CDM executive board. In 2012, the methodology for forestation of degraded land using bamboo species was approved under the Panda Standard for a Panda project in Xishuangbanna, Yunnan province.

Since 2006, the afforestation and reforestation in China has benefited from five CDM projects as seen in table 1, and one Panda project for bamboo afforestation in Xishuanbana, Yunnan province. In addition, the China Green Carbon Foundation, established in 2010, also provides financial support for afforestation and reforestation projects with funds raised by various means including online tree planting (Li, 2013). It designs and organizes diverse programs such as carbon neutral programs which involve people to support carbon forestry. There is no REDD+ funded project in China yet. China is still in the preparatory phase for REDD+.

Table 2. An overview of CDM afforestation and reforestation projects in China.

No.	Project title	Estimated annual carbon reduction (tco$_2$e)
1	Facilitating reforestation for Guangxi Watershed management in Pearl River Basin	20,000
2	Reforestation on degraded lands in North West Guangxi	70,272
3	Afforestation and reforestation on degraded lands in North South Sichuan	26,000
4	Afforestation and reforestation on degraded lands in South West Sichuna	40,214
5	Small-scale afforestation for desertification combating at Kangping County, Liaoning	1,124

Source: China CDM project database.

4. Advantages and challenges

Carbon forestry is an integral part of China's climate targets, which means top priority, strong political will and more financial support from the government for it. China has launched various awareness-raising campaigns organized by the government at multiple levels, media and NGOs. As a result, elevated awareness in China is observable not only by the policymakers, but also by many businesses and the mass (especially urban) public (Held et al., 2011; Stensdal, 2012). It is rooted in the minds of many people that climate change has serious consequence for China and urgent actions should be taken, which will motivate the people's contribution to carbon forestry.

China had a lot of experience in afforestation and reforestation gained over the recent decades. Such experience can be very conducive to effective carbon forestry. In addition, the national forest carbon inventory pilot project over the entire country can be helpful for the development of statistically sound and transparent carbon inventory methods to be used for carbon forestry. Despite the above-mentioned advantages, there is a wide range of challenges facing carbon forestry. The major forest policy constraints include the annual logging quota (ALQ) system, uncertainties of the forestland tenure and logging ban on the natural forests (Yang, 2001). All of these constraints will pose difficulties in implementation of forest management improvement.

The modalities and procedures under CDM are complex, and CDM project development is costly and unfordable for poor forest farms and smallholders, who usually have no access to loans or credit either. This will force them to do the business as usual in their forests, which accounts for more than 60% of the total forest area in China. Furthermore, potential risks in carbon markets may temper the interest of forest owners in carbon forestry.

For afforestation, reforestation and forest management improvement, sufficient skillful foresters with essential knowledge of carbon forestry are indispensable. Otherwise, carbon forestry cannot work on the ground. However, the reality in China is that there are only a very limited number of such foresters in many forest areas.

Many forests in China are on marginal lands. Awareness of climate change in those areas remains usually low in spite of awareness-raising campaigns. It is imperative that awareness-raising programs specific to the rural foresters should be developed for the promotion of their interests and participation in carbon forestry.

Several scientific and technical challenges may arise from carbon forestry implementation, such as the selection of tree species, thinning schemes and strategies for forest carbon monitoring, reporting and verification (MRV).

5.   Conclusions

Carbon forestry has earned a key priority in China due to the large biophysical potential of China's forests for climate change mitigation. Despite various advantages, a number of challenges have to be addressed in a comprehensive context in order to benefit from carbon forestry implementation. In general, carbon forestry is more of an opportunity than a challenge for sustainable forestry development in China.

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Carbon impacts of forest restoration of natural degraded forest in Ha Tinh Province, Vietnam

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Abstract

The primary objective of this study is to identify the scenarios of carbon sequestration or retention potential of the identified project area in Ha Tinh province. Specifically, this study addresses technical and methodological issues of estimating the carbon sequestration and/or retention potential and estimates the carbon benefits that may accrue with and without restoration activities. The scope of the study is limited to broadleaf evergreen forest ecosystems in Ha Tinh province. In particular, the study investigates the technical and economic potential for "enrichment" of areas of regrowth and poor forests that are classified as Protection Forests. The method applied in this study is consistent with international principles and systems for the measurement of forest carbon and forest emissions/ removals of GHGs, particularly the guidance provided by the United Nation Framework Convention on Climate Change (UNFCCC). Forest Reference Emission Levels (RELs) and the potential impacts on forest carbon of the ENRICH project are estimated based on available data including forest surveys undertaken for ENIRCH, third party data and international studies.

1.   Introduction

Vietnam's forest cover declined from 43% to 27% between 1943 and 1990. Since then, Viet Nam has made considerable efforts to increase its overall forest cover, which now stands at 13.39 million ha or 39.7% of its total area. The increase has been mainly due to new plantations, which account for 2.92 million ha. Despite this increase, the quality of natural forests continues to decrease, suffering from fragmentation and degradation. Over two-thirds of Viet Nam's natural forests are considered poor or regenerating, while rich and closed-canopy forests constitute only 4.6% of the total forest area. The area of natural forest classified as rich decreased by 10.2% between 1999 and 2005, and the amount of medium quality forest declined by 13.4%.

   Forests play a vital role in sequestering and removing Greenhouse Gases (GHGs) from the atmosphere and are an important store or "sink" of carbon. The degradation and loss of tropical forests is one of the key drivers of climate change. In 2000, Land Use, Land Use Change and Forestry (LULUCF) was estimated to make a net contribution to Greenhouse Gas

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emissions in Vietnam of over 15 million tones, equivalent to 10% of Vietnam's total emissions.

Addressing the degradation and loss of tropical forests is thus a central element in efforts to mitigate climate change. Reducing Emissions from Deforestation and forest Degradation in developing countries (REDD+) goes beyond deforestation and forest degradation, and includes the role of conservation, sustainable management of forests and enhancement of forest carbon stocks. The REDD+ concept has gained traction and momentum in recent years as a viable way to address the climate change impacts associated with forest degradation.

The Government of Vietnam (GoV) has launched a range of initiatives and reforms in the forestry sector with the aim of increasing forest coverage and improving forest management. In parallel, Vietnam's National Target Program to Respond to Climate Change (2008) and National Strategy on Climate Change (2011) aim for the "protection and sustainable development of forests, increasing carbon removals and biodiversity conservation" as one of its key strategies. Within this framework, the Ministry of Agriculture and Rural Development (MARD) is responsible for the forestry and agriculture sectors and in 2011 MARD developed the *Action Plan to Respond to Climate Change of the Agriculture and Rural Development Sector in the Period 2011-2015 and Vision to 2050*. Under this Action Plan, in 2012, MARD established a target to reduce emissions from the agricultural sector (including forestry) by 20% by the year 2020. In June 2012, the GoV approved the National Action Program on "Reducing Emissions from Deforestation and Forest Degradation, Sustainable Management of Forests, Conservation of Forests and Enhancement of Forest Carbon Stocks" in the period 2011-2020. This is known as the National REDD+ Action Program and confirms the target to reduce emissions from the forestry sector by 20% by 2020. For the forestry sector, the main activities anticipated to help meet this target are:

- Extend forestry plantations, and restore degraded forests with a target of 2.6 million ha for potential net GHG emission reduction of 702 million tons CO2e.
- Protect, develop and sustainably manage forests to increase carbon sequestration and reduce GHG emissions over an area of 13.8 million ha, leading to a potential net GHG emission reduction of 669 million tons of CO2e.

Given the current state of many of Viet Nam's forests, regeneration and restoration of forests is identified as a target action. Recent success with forest plantations and regeneration of secondary forests, suggest that there is considerable scope for enhancing carbon stocks across Vietnam. However, natural forest regeneration is becoming more difficult due to the isolation of the remaining rich natural forest patches.

2.   Study area

The project "Advancing Understanding Forest Carbon Stock Enhancement as part of REDD+", or "ENRICH", is being implemented with the support of the German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB), the

Netherlands Development Organisation (SNV), and the Vietnam Administration of Forestry (VNFOREST). The project aims to advance understanding of forest carbon stock enhancement as part of any future REDD+ agreement through exploring the technical and economic feasibility of different forest carbon stock enhancement strategies in pilot sites across Viet Nam and Lao PDR. Unlike most other REDD+ efforts to date, the focus of ENRICH is on enhancing degraded forests rather than reducing the rate of degradation or deforestation. The project also aims to better understand the socio- economic feasibility of different options and the incentives which need to be in place to engage local communities and improve their living conditions. The results and operational guidance will feed into the National REDD+ Strategies, which will ensure their replication across both countries.

In Ha Tinh province, the broadleaf, evergreen forest ecosystem in Ke Go Nature Reserve (KGNR) located in Huong Khe, Cam Xuyen and Ky Anh districts, has been selected as a pilot site. KGNR comprises a 24,801 ha area within one of the largest remaining blocks of broadleaf evergreen forest in the lowlands of central Viet Nam. KGNR encompasses a representative sample of the lowland forest habitats which formerly extended throughout the coastal plains of central Viet Nam but which have now been largely cleared for agriculture. KGNR was previously classified as Production Forest and, as a result, was subject to commercial logging for a number of years[1].

3.   Study method

To design a suitable and valid method for estimating the GHG removals by the ENRICH project, reference is made to the international REDD+ context and internationally recognized schemes. The method applied in this study is consistent with international principles and systems for the measurement of forest carbon and forest emissions/ removals of GHGs, particularly the guidance provided by the UNFCCC, formally adopted at the UNFCCC Conference of the Parties (COP) in November 2013.

Accurate and reliable measurement, reporting and verification (MRV) of GHG emission reductions is required for all forest carbon projects or programs where external funding or recognition is sought, including for projects and programs registered with a carbon scheme, and results-based donor initiatives. MRV of sectoral scope is also required in a number of contexts under Viet Nam's obligations and commitments to the UNFCCC as part of the Kyoto Protocol, particularly for Nationally Appropriate Mitigation Actions (NAMAs) and REDD+ initiatives. Non-Annex I countries, such as Viet Nam, are requested to submit a National Communication on GHG Inventories to the UNFCCC every four years, with a biennial update. Viet Nam submitted its Second National Communication to the UNFCCC at the end of 2010.

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[1]http://birdlifeindochina.org/content/investment-plan-ke-go-nature-reserve-ha-tinh-province-vietnam-contribution-management-plan