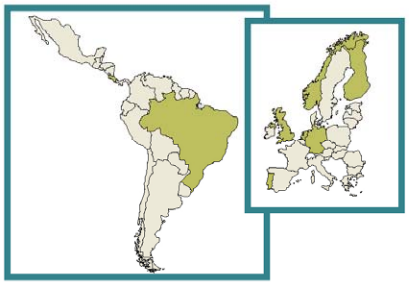

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A review of the cost-effectiveness and performance of selected Verifiable Emission Reduction (VER) carbon offsets

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The POLICYMIX and FunciTree Technical Brief is an occasional series presents work in progress shared by both projects. All Briefs are also available online: **http://policymix.nina.no**; **http://funcitree.nina.no**

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A review of the cost-effectiveness and performance of selected Verifiable Emission Reduction (VER) carbon offsets

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Abstract

The Report discusses the alternative approaches for research projects to off-set their GHG emissions using examples developed in two EU FP7 research projects coordinated by NINA, POLICYMIX and FUNCiTREE. The Report discusses pros and cons with different emissions reductions schemes.

Summary

It has been estimated that 56% of CO2 emissions come from fossil fuels. The impact of fuel consumption in air travel is 1.9 times greater than fuel based emissions on the ground. Air travel is also often the largest single source of carbon emissions in research; environmental research is no exception. Where air travel cannot be reduced, carbon emission can be offset with carbon sequestration and/or avoided deforestation. Deforestation and forest degradation contribute to around 17% of the total carbon emissions, globally.

FUNCiTREE and POLICIMIX, two European Union FP7 research projects have decided to offset their travel carbon emissions for the life of the projects 2009-2014. This report sets out to identify cost-effective and sustainable carbon offsetting programmes from which these projects can purchase offsets. Certified emission reductions (CER) is under the UN CDM and emission quota system, while verified emission reductions (VER) involves the voluntary market. Both CER and VER follow comparable designing, certification and verification methods. CER focus on alternative energy projects such as wind and hydropower projects, while VER concentrates on forest carbon offsetting projects.

Organizations involved in certifying carbon offsetting projects include, UNFCCCDM, Plan Vivo, Chicago Climate, American Carbon Registry, Gold Standard, Greenhouse Gas Reduction Scheme and Ticos. The review of selected carbon offsetting projects in this technical brief shows that the cost of carbon offsetting projects ranges from 0.14 to 125 Euro per tonn of carbon sequestered or avoided emissions

during the life time of projects. Cost of carbon offsetting projects is dynamic and influenced by economies of scale, opportunity costs, and type of project, region, carbon discounting rate, and prices of other commodities such as oil. Additionality, permanence, leakage, verification and buffer are some of the major crucial issues that determine effectiveness of carbon offsetting projects. Avoided emissions can conserve a carbon pool, offer high provision of ecosystem services, sequester some additional carbon and has low establishment cost. They also have a strong potential to enhance rural livelihoods if the appropriate standard is applied. Relative to avoided emissions, sequestration projects have higher establishment cost, but often offer better local employment opportunities, and can sequester more carbon.

Plan Vivo projects were chosen for a more in-depth evaluation given availability of on-line documentation and its long experience in carbon offsetting forest projects. Plan Vivo was initiated from a Joint Implementation (Kyoto mechanism) project in Mexico, subject to independent research, and later launched in the voluntary carbon market with avoided and sequestration projects. Up to now Plan Vivo in Mexico has issued 470,103 tonnes CO2 which covers 2,437 smallholders and community groups on 9,645 hectare of land. We conclude that purchasing carbon credits from the Plan Vivo pioneering project in Scole Té Mexico, FUNCiTREEand POLICIMIX can offset their carbon emissions with inexpensive carbon, while encouraging the voluntary carbon market, contributing to enhancing rural livelihoods, protecting biodiversity and conserving ecosystems. Purchasing carbon offsetting credits can also help research organizations to get primary data to examine challenges and opportunities of carbon offsetting projects, to initiate research projects, and propose workable methodologies and polices aiming to fulfil various objectives such as carbon balancing, nature conservation and development.

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Contents

1 Introduction

CO2 emissions from fossil fuels comprise 56% of total global emissions (IPCC, 2011). CO2 and other green house gas emissions by airplanes pollute the upper atmosphere (Brown and Roughgarden,1997) and the impact is 1.9 times greater than releasing GHG on the ground due to radiative forcing (IPCC, 1999). Pruchasing carbon offsetts is an effective way for research projects to compensate for air travel when it cannot be avoided and reduce research institutes non-negligible carbon footprint. Two of NINAs EU FP7 projects, FUNCiTREEand POLICIMIX, intend to demonstrate how to offsetting their carbon emissions from travel in a simple cost-effective way, hoping to lead the way as environmental research projects.

Similarly, carbon emission from forest degradation is an enormous potential danger for global warming. Carbon emission from deforestation represents 17.3% of all greenhouse gas emissions currently, the second largest source after fossil fuels. Yet, the total global carbon pool in forest vegetation has been estimated at 359 GtC (gigatonnes of carbon). Compared to the current annual global carbon emission from industrial sources, which is approximately 6.3 GtC, deforestation is a very large potential source of carbon emission. Forest carbon management, therefore, must be an important element of any international agreement on climate change (IPCC, 2000; Karky et al. 2010; De Jong et al. 2000). Consequently, land use, land use change and forestry (LULUCF) has been proposed by the United Nations Framework Convention on Climate Change (UNFCCC) as one of the mechanisms for carbon offsetting alternatives (IPCC, 2000). This is also a natural sector for offsetting activities by NINA projects, as most of our research activity addresses biodiversity issues due to LULUCF.

FUNCiTREE(2009-2013) and POLICIMIX (2010-2014) had budgeted emissions of 115 CO2e and 848 CO2e tonnes and an estimated total of 556 000 and 3.6 million km of travel, respectively, during the course of the two projects. For comparison NINAs estimated total air travel registered with Via Travel for 2009 was around 3,1 million km. FUNCiTREE and POLICIMIX have budgeted a total Euro 14400 and Euro 21465, respectively for purchasing carbon offsets from a transparent and an efficient LULUCF project.

The carbon trade involves two broad categories. These are the cap-and-trade or the compliance system under which certified emission reduction (CER) is grouped and the voluntary carbon market which mainly works with verifiable emission reductions (VERS). VERs is also further categorized by the type of project. It includes solar, wind and other energy efficiency activities. Others, for example Plan Vivo VERS, are forest related projects. Agro-forestry, afforstation, reforestation and conservation projects – LULUCF activities - are the most relevant activities for FUNCiTREE and POLICIMIX to buy carbon offset credits from. However, previous studies on cost-effectiveness of forest related verifiable reductions are neither sufficient nor rigorous (Caplow *et.al* 2011).

2 Objectives of the study

Identify cost effective and sustainable carbon offsetting projects from which FUNCiTREE and POLICIMIX can purchase carbon offsets.
Compare and contrast pros and cons of CERS versus VERS and avoided emissions versus sequestration.
Evaluate the cost-effectiveness of avoided emissions and sequestration carbon from selected offsetting projects including an evaluating of practical issues of purchasing carbon credits.

3 Certified emission reduction (CER) and Verifiable emission reduction (VERS)

Considerable numbers of organizations are involved in carbon emission reduction markets. Some of these organizations are Chicago Climate, American Carbon Registry, Climate community and Biodiversity Standard (CCBS) , Gold Standard, UNFCCC CDM, UNFCCC JI, Plan Vivo, Greenhouse Gas Reduction Scheme and Ticos. Climate community and Biodiversity Standard (CCBS) certify social benefits of carbon offset projects.

The United Nations Frame work for climate change, Clean Development Mechanism (UNFCCC CDM) works with both forest related and other carbon offsetting mechanisms in the regulated carbon market. UNFCCC has developed methodologies and standards for large- and small-scale afforestion and reforestion CDM project activities. In addition, standard tools have aslo been developed to adress problems such as additionality, establishing baseline senario, and permanence. Simillarly, Plan Vivo is working on the carbon emisison market focusing on voluntary verifiable emissions related to natural forest, plantation and agroforestry carbon offsetting mechanisms. However, carbon accounting standards, design, data collection, and analysis methods still lack rigor (Caplow *et al.* 2011).

Certified emission reductions (CER) is under the Clean Development Mechanism program, or treaty-regulated offsets, while the verifiable emission reduction (VER) involves the voluntary market. The Clean Development Mechanism allows a country with an emission-reduction commitment to get a saleable certified emission reduction credit. Each credit is equivalent to one tonne of CO2. The system is designed to give the chance to developed countries to meet Kyoto targets in a flexible way while alleviating poverty in developing countries (UNFCCC, 2011). Verified Emissions reduction Credits (VERS) are credits which are neither recognised by, a formal part of, the Kyoto protocol, EU ETS nor verifiable in the same way as other carbon credits. However, many providers of VERS follow CDM verification standards. VERS are designed to attract the voluntary market. The type of projects they focus is another difference between CERS and VERS. They are often be linked to small, non-industrial projects. Only 28 out of 2782 CDM currently registered projects are afforestation and reforestation projects. But, in the voluntary carbon market for example Plan Vivo projects are almost all afforestation, reforestation and agro-forestry projects (UK Energy and Climate change 2011).

Certified emission reduction credits involve special ways of issuance in forest projects. “Temporary CERs” and “long CERs” are special types of CERs issued for forestry projects. Temporary CER or tCER is a CER issued for an afforestation or reforestation project activity under the CDM which expires at the end of the commitment period following the one during which it was issued. Long-term CER or lCER is a CER issued for an afforestation or reforestation project activity which expires at the end of its crediting period (UNFCCC, 2006).

Only a small number of sectors and only a few counties are covered by the mandatory cap and trade system. However, some individuals who are not obliged and some companies which are not forced to offset their carbon emissions are willing to offset their carbon emissions. The reasons why these organizations and individuals engage in voluntary emissions reduction schemes include addressing climate

change, generating goodwill amongst customers and employees, learning by doing, and corporate social responsibility. These companies and individuals have laid the foundation for the birth of the voluntary carbon market (Forum for the Future, 2008). Some voluntary carbon credits such as Gold Standard work on both CERS and VERs. Others organizations such as Plan Vivo work only with VERs. Plan Vivo has registered 1,001,793 tCO2 VERS certificates up to now (www.Plan Vivo.org).

4 Controversial issues in carbon offsetting from forest and agroforestry projects

Leakage

Leakage is the net change of anthropogenic emissions by sources of greenhouse gases which occurs outside the project boundary, and which is measurable and attributable to the project activity http://www.cdmrulebook.org). Leakage can be negative or positive. When an emission of carbon occurs somewhere outside the boundaries of a project area as a result of the pressure created by the carbon offsetting project, a positive leakage occurs. Conversely, if carbon sink is observed somewhere else outside the project area due to the impact of the carbon offsetting project, it is a negative leakage. For example, protection of a certain forest, bushland as carbon offsetting projects, may force the local community to deforest another unprotected area for fuel and other wood products. Similarly when carbon credits are provided to carbon forests, but not to industrial forests, industrial firms may reduce investments in new forests. These effects would be termed positive leakages. In addition the level of competing uses for land affects the intensity of leakage effects. Land that has high competing uses tends to show high leakage risk. Changes in national or international policies also can cause leakage (IPCC, 2001). A previous study in Patagonia, Argentina estimated that leakage from industrial forests, due to forests established for carbon purposes was about 40% (Sedjo, 1999). Similarly a CDM tree-planting project in Tanzania resulted in a negative leakage of 60-120% of the certified emissions reductions as registered in the CDM tree plantation project (Glomsrød *et.al* 2011).

Both the compliance and the voluntary carbon credit markets have designed standards to control leakage. Both the standards and sources of leakage are project specific. The methodology for afforestation and reforestation of degraded lands as a CDM project, for example, has treated emission from fuel during seedling transportation as a leakage (UNFCCC, 2006).

Additionality

Additionality is defined as reduction in emissions of carbon by *sources* or enhancement of removals of carbon by sinks that is additional to that would occur in the absence of a carbon offsetting project. It also comprises financial and technological additionality (IPCC, 2001). Generally, additionality is a key requirement of the carbon emission reduction projects. It is all about being real, measurable and additional. The CDM tools for assessment of additionality include identification of alternatives to the project, investment analysis, barrier analysis and common practice analysis. Barrier analysis involves financial and/or economic, technical institutional/political and ecological, and social and cultural barriers. However, technical specifications do not guarantee implementation of the designed additional offsets. Evaluation of the CDM projects on sulphur dioxide emission reductions in China for example, confirmed that there was no significant additionality after the implementation of the projects (Zhang and Wang, 2011).

Permanence

Permanence is the likelihood that sequestered carbon will not be released into the atmosphere at some point in the future. Since terrestrial ecosystems involve risks such as fire, pest and illegal human activities, carbon offset projects in such areas entertain risk of non-permanency. Carbon registries in the United States use conservation easements and other legal instruments to reduce the risk of non-permanence (Egan and Seidenberg 2009). In the Plan Vivo project registration guideline permanency is understood as maintaining permanent land use change after the implementation of the new project (Plan Vivo, 2008). The Clean Development Mechanism (CDM) assigns temporary credits for forest carbon offset projects that are only valid for a limited period of time. Upon expiry, these credits need to be replaced either by verifying the project again to ensure the carbon savings are intact or by buying new permanent credits from another project. Moreover, using insurance as an instrument to deal with non-permanence has been proposed in the methodology of land use change and forestry CDM projects (UNFCCC, 2002). However, verification is costly. In the case of Plan Vivo projects for example verification is performed by a third party every five years. The third party sends experts to the projects. Experts collect data from the project and produce a verification document. The verification activity is almost as costly as designing a new project. In future, designing simplified verification techniques such as online registration and remote sensing can reduce cost in some areas.

5 Cost of carbon offsetting forest projects

The major cost categories of carbon offsetting projects include project implementation, transaction and farmer opportunity costs (explained below). Carbon offsetting project costs can also be categorized into social and private costs. Previous studies of cost effectiveness of carbon offsetting projects have followed different cost-effectiveness estimation methods. Some studies have considered both transaction and opportunity costs (example, Torres *et. al* 2010). Others have estimated only technical costs and concluded that carbon offsets are a feasible alternate to other land uses (example, Takimoto *et al*. 2007). Moreover, project developing guidelines of both voluntary and the compliance carbon offsetting projects have hardly identified a specific method for cost-effectiveness estimation. The guidelines do not require estimation of cost during project designing, more attention is given to the technical design of the project. Consequently, most of the carbon offsetting forest projects of both the compliance and the voluntary sort have neither cost estimations, nor identified cost types.

Implementation costs of carbon offsetting forest projects

Implementation costs include material and labour costs incurred to establish an offset project. Costs for , seed collection, seed storage, seed germination, nursery establishment, seedling raising, land preparation, planting, weeding, cultivating and guarding costs can be grouped in this category. In case of avoided emissions technical costs may consist of costs for guarding, enrichment planting, forest road construction and fire break construction. Job training and administration might also be included. These categories of costs are non-avoidable costs to establish carbon offsetting projects. However, the magnitude of these costs vary depending on the scale of the project, current wage rates, material prices, location and other factors. The initial implementation costs for Scolel Té as a whole was $850 000 for 28 000 ha ($30, 35 per ha) (De Jong et al. 2004). Scolel Té has involved high implementation costs as a pioneer project. Most of the costs were fixed transaction costs. Researchers have ventured that implementation costs could be reduced by up to 50% as Scolel Té gained experience and was scaled up (Torres et al. 2010).

Transaction costs of carbon offsetting forest projects

Transaction costs are cost of exchange, cost of bargaining, information, measurement, supervision, enforcement. Sometimes costs of land tenure and governance reform (primarily for REDD mechanism) are included in this category as well. Voluntary market transactions between agents are costly because it requires information, making contracts, monitoring, enforcing compliance and making decisions (Paavola and Adger 2005). Transaction cost affects optimal choice and design of policy instruments. It is also used as a concept for measuring the relative efficiency of alternative institutional/property rights arrangements (McCann, 2005; Musole, 2009). Transaction costs in the case of carbon offsetting forest projects can include i.e. cost of registration as a voluntary carbon offsetting projects such as Plan Vivo or as a CDM project, monitoring, verification, and promotion. Project design document, validation and registration are fixed costs of CDM projects and ranges from $43 000 -$ 210 00 per project (Bauer *et al.* 2005).

Opportunity costs

Opportunity cost is an alternative that must be forgone in order to pursue a certain action or it is the benefits one could have received by taking an alternative action. The common opportunity cost in case of carbon offsetting forest projects is the opportunity cost of land. In the case of sequestration the total benefits to the farmer of carbon offsetting forest projects should exceed the benefit that would be obtained from other alternative agricultural products. The costs of carbon savings in the forestry projects studied in Central America for example, was highly dependent on the opportunity cost of land (Swisher, 1991). Opportunity costs can be measured in different ways, ranging from static cost benefit analyses to dynamic modelling, econometric analyses and mathematical programming models (Börner et al. 2009). Fig.1. shows the cost curves of Scolel Té project. The code with figures and letters stands for carbon sequestration potential and type of agro-forestry activities respectively. Activities include a number of different management standards, (1) Reforestation, (2) improved fallow (3) Live fence, (4.) Improved fallow, (5) improved coffee (under shade). The figure clearly shows how economics of project scale (area, ha) and type of agro-forestry activity influence the cost of a tonne of carbon. Average cost curves are downward sloping because of fixed transaction and implementation costs of establishing projects .

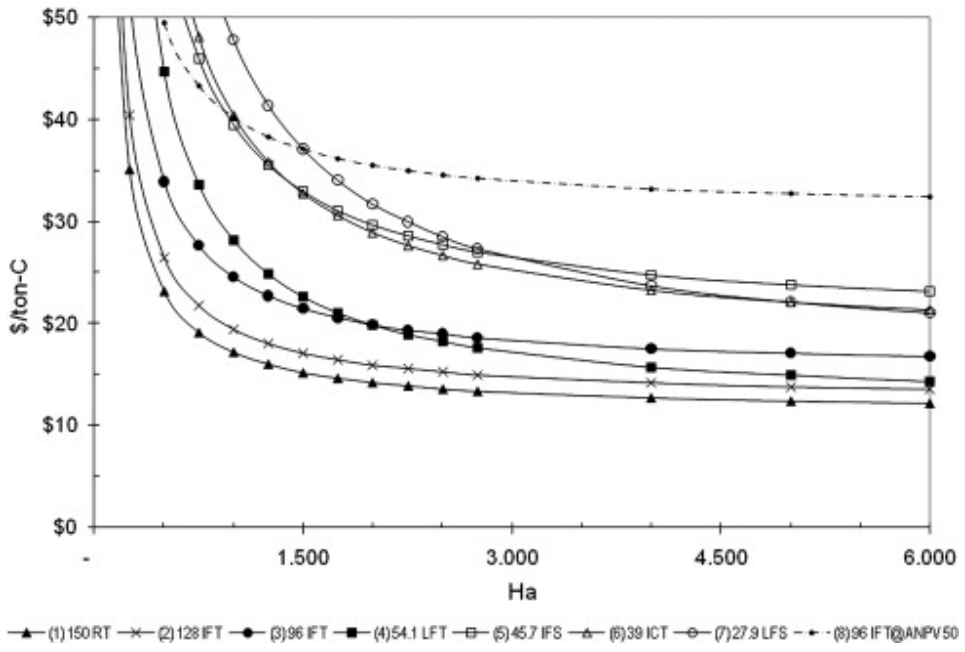

Fig. 1. *Sequestration cost curves considering initial transaction and implementation costs (Torres et al. 2010).*

Similarly, table 1 shows the costs of carbon offsetting forest projects in different parts of the world. The detail study and method of each project can be obtained from the respective studies. Generally, avoided emission projects are less costly compared to sequestration. For example, the Guyana Rainforest has the least cost per tonne of carbon (tc) among the projects listed in table 1. Similarly Nepal community forest has the second lowest cost. Sequestration projects such as for example West African Sahel live fence demonstrates the high cost per tc of this kind of projects (table 1).

Table 1 *Examples of cost estimation of carbon offsetting natural forest, plantation and agro-forestry projects*

Source	Type of Project	Location	Cost euro/tC
Osborne and Kiker, 2005	Guyana Rainforest	S. America	0,14
van Kooten *et al.,* 2004	981 forestry estimates	global	32,37-180,73
Pajot, 2009	South west French forest (Carbon sequestration forest)	France	38.8 -78.4
Karky and Skutsch, 2010	Community forest	Nepal	0,76-5,14
Alavalapati, 2007	Fodder Bank	W. Africa S.	124,5
Borton *et al.* 2010	*F. albida* and *V. paradoxa* A. forestry	Mali	40
Swisher, 1991	Central America		5-13
Torres *et al*. 2010	afforestation, agro-forestry, reforestation	Scolel Té,Mexico	8,58-20,15[1]
Alavalapati, 2007	Live fence	W. Africa S.	75,68

Table 2. *Mitigation potential and cost effectiveness of the 11 species*

Type of mitigation option	Mitigation potential (t C/ha)	NPV benefit (Euro/ha)a	Life cycle cost (Euro/ha)b	Investment cost (Euro/ha)c
Rubber	128	14,58	90,96	50,69
Oil Palm	109	224,97	96,51	22,91
Rambutan	118	215,94	103,46	62,49
Meranti	254	9,03	65,27	11,11
Durian	133	658,24	103,46	62,49
Albizia	53	527,70	84,02	14,58
Duku	115	267,32	103,46	62,49
Mangga	121	1287,32	206,92	124,98
Macang	121	331,90	103,46	62,49
Pinang	63	112,48	65,96	11,11
Kemiri	125	329,12	65,27	11,11

Source: (Sathaye and Andrasko, 2007)

Note: Discount rate was assumed to be 10%

[a]NPV = Net Present Value

[b]Life cycle cost refers to the discounted value of all costs to the end of rotation

[c]Investment cost = Initial cost including land acquisition cost, land preparation, planting and early tending

[1] More recent estimates by Plan Vivo put costs at 8USD per t/C or 3USD per t/CO2 for Scolol Té (pers. com. Sandie Fournier, Ambio).

Another cost estimation of carbon offsetting forest projects from Indonesia has investigated eleven different plant species. The study shows how mitigation potential, net present value, life time cost per tc and investment cost per tc depends on the type of plant species. The mitigation potential ranges from 63 tc per ha to 254 tc per ha for Pinang and Meranti species respectively. Meranti has also the lowest investment cost per tc (Table, 2). Generally, sequestration costs are affected by both economies of scale, opportunity costs, type of agro-forestry, region, carbon discounting rate, date of study and review and prices of other commodities such as timber and oil (Lipper 2007, Torres et al. 2010; van Kooten et al., 2004; Pajot, 2009).

6 Pros and cons of conservation avoided carbon emission and carbon sequestration forest projects

The main difference between sequestration and avoided emissions is that, avoided emissions are conserving the carbon pool while sequestration is uptake of carbon from the atmosphere. In the case of LULUCF, avoided emissions is to reduce carbon emission by deforestation. Avoided emission in forest projects are based on the principles of Reduction Emissions from Deforestation and Forest Degradation (REDD) program. REDD is an effort to create a financial value for the carbon stored in forests, offering incentives for developing countries to reduce emissions from forested lands and invest in low-carbon paths to sustainable development. "REDD+" considers additional objectives of offsetting projects such as the importance of biodiversityconservation, sustainable management of forests and enhancement of forest carbon stocks in addition to reducing deforestation and degradation. (http://www.un-redd.org/AboutREDD/tabid/582/Default.aspx).

Forest as a carbon mitigation scheme generally can combine both sequestration and avoided emissions schemes. As a result forest carbon mitigation projects play a unique role in carbon mitigation. However, conserving existing natural forests, old plantations and agro-forestry systems is more of avoided emission scheme. In addition to natural forests and plantations different agro-forestry systems such as silvipastoral systems and homestead agro-forestry systems are important carbon pools (see e.g. Takimoto et al. 2007, Torres et al. 2010). Large wood lands serve as a grazing land in different countries. Such silvopastoral agro-forestry systems are exposed to over grazing, deforestation and degradation. In addition live fences, scattered trees and homestead agro-forestry systems are also deteriorating in many countries due to population pressure followed by high demand for wood and forage. Therefore, conserving, natural forests, plantations, park trees, live fences, silivpastoral wood lands and other agro-forestry systems from devastation can be considered as an avoided carbon project. Increased atmospheric carbon sequestration can be obtained by establishing plantations and agro-forestry systems in non-forested land, and by managing existing young plantations and young agro-forestry systems. Such an activity can be grouped into sequestration scheme. Some pros and cons of avoided versus sequestration schemes are presented in table 3.

Table 3. *Potential pros and cons of avoided emissions and carbon sequestration schemes in land use, landuse change and forestry, LULUCF*

Type of project	Pros	Cons
Avoided (conservation)	• Biodiversity conservation • Carbon pool conservation, some additional carbon fixation • Relatively low cost • Rural forest livelihoods conservation • Local forest management capacity building	• High risk of natural disasters • High risk of illegal cutting • High risk of leakage • Compensation to landowners often less than opportunity costs
Sequestration (establishing agro-forestry, plantation)	• Job creation in silviculture, agroforestry • Harvesting additional food and fodder • Increase forest cover • Small land holders can participate • Carbon removed from the atmosphere through fixation and storage in biomass	• High risk of low survival rate • Long gestation period • Less ecosystem services than in established forest • High establishment cost • Competition with crops for land • High risk of failure due to climate and other natural hazards

Note: potential pros and cons will vary across concrete projects and contexts, illustrating some of the difficulties in adopting a general position for or against avoided emissions or sequestration projects.

Agro-forestry is a deliberate growing of woody perennials on the same unit of land as agricultural crops and/or with animal husbandry, either in some form of spatial mixture or sequence where significant interaction (positive and/or negative) between the woody and none woody components of the system, either ecological and/or economical exists (Nair, 1992).

Agro-forestry practices can be divided based on the nature of agro-forestry components (agri-silviculture, silvo-pastoral, agri-silvopastoral), arrangement of components (mixed dense, sparce, strip, boundary), function (food, fodder, fuel wood, shelter, soil conservation) and agro-ecological zone adaptability. Major agro-forestry practices include: Improved fallow, Taungya system (crop growing in plantations during the early age of the plantation), alley cropping (hedge raw intercropping), multilayer tree gardens, multipurpose tree on crop land , home gardens, trees in soil conservation and reclamation, wind breaks and live fences. Uses of agro-forestry include wood production, fodder, and production, increasing soil fertility thereby increasing crop yield, wind break, recreational, protection, carbon sequestration soil and water conservation, biodiversity conservation (Nair, 1992; Nair et.al, 2010).

Agro-forestry is one of the oldest land use system with tremendous uses. It can serve as a tool for carbon sequestration while providing sustainable food and other products. Increased likelihood of droughts (Ref. IPCC 2007) is one of the major disasters of climate change predicted for large areas of tropical sub-humid to arid regions. Annual crops are more susceptible to drought than perennials and can benefit from the presence of trees, a major component of agro-forestry system. There are many ways the trees affect

the understorey vegetation but trees can 'share water' for instance as in the case of hydraulic lift (a particular physiological mechanisms by which tress conduct water through the stems from deep layers and by which water is passively moved to drier superficial layers or by reducing evapo-transpiration through shading. Under conditions of stress often, the kind of interaction between trees and the understorey vegetation is of facilitation which can mitigate the effects of drought on the crop/pasture (Pugnaire and Luque 2001).

Agro-forestry as a land use systems is believed to have a higher potential to sequester carbon, because of its favourable structure to utilizing growth resources efficiently compared to mono-cropping or pastoral systems. Agro-forestry is estimated to be practiced over 1 billion hectares in developing countries. It is a sustainable land use system which can store carbon both in bellow and above ground biomass and in the soil. Its effectiveness in mitigating carbon emissions depends on species type, management practice, environmental factors and location (Kumar, 2011). Agro-forestry practices which do not require full land use conversion for example live fences can be easily exercised as carbon offset project (Torres et al. 2010).

7 Plan Vivo and its carbon offsetting projects

There are several reasons why the rest of the analysis focuses on Plan Vivo projects. Plan Vivo has collaboration with research in documentation of costs. A number of articles has been published on performance and cost effectiveness of Plan Vivo projects. It is a pioneer research-based project. Most of the Plan Vivo projects have online documents which show the detail planning, reporting and verification procedures. Plan Vivo focuses on voluntary market and forest related projects. Plan Vivo as a principle considers both the ecosystem and livelihood at a household level. Plan Vivo standards are similar to the UNFCCC standards.

Plan Vivo is one of the organizations working in the voluntary carbon market mainly with forest carbon offset projects[2]. The Plan Vivo system is a framework for developing and managing community-based land-use projects with long-term carbon, livelihood and ecosystem benefits. It was initiated from a research project in Mexico. Now it is a globally accessible standard which is extending its example to many countries. Plan Vivo stakeholders create sustainable land-management plans by combining existing land-uses with additional eligible project activities such as afforestation (not commercial plantations), agro-forestry, forest restoration and avoided deforestation (forest conservation) (Plan Vivo Foundation, 2011).

Plan Vivo five key project developing steps are (i) community led planning, (ii) writing Plan Vivo and quantifying carbon services, (iii) payment agreements for ecosystem services, (iv) monitoring and (v) payments. Stakeholders and supporters of Plan Vivo include USAID, DFID, Green Belt Movement, Wildlife Conservation Society, William J. Clinton and Hunter Foundations, Mercy Corps, World Agro-forestry Centre (ICRAF), Rainforest Alliance, the Waterloo Foundation, the International Development Research Centre, the University of Edinburgh, and A Rocha International (www.Plan Vivo.org).

Plan Vivo has prepared its own standards and specifications for the carbon offset registration process. Plan Vivo standards are designed to accommodate workable systems to promote sustainable rural livelihoods in developing countries. It also allows working with small scale producers to deliver ecosystem services, specifically long-term carbon sequestration and/or emission reduction benefits and promote the protection and/or planting of native or naturalized tree species. The major Plan Vivo requirements and standards include:

- The project must have an effective governance structure.
- Planting activities must be restricted to native and naturalised species.
- Project has undergone a producer/community-led planning process
- Project has an effective process for monitoring the continued delivery of the ecosystem services,
- The project must analyze financial, social, cultural, technical, ecological or institutional barriers and proposed solutions.
- Carbon benefits must be calculated using recognised carbon accounting methodologies (Plan Vivo Foundation, 2008).

[2] The Foundation Plan Vivo has not published their energy standards yet but they should so in 2012(fuel efficient stoves project, etc.)

Up to now Plan Vivo Foundation has issued 1,001,793 tCO2 which covers 5,226 smallholders and community groups and 22,771 hectares of land. It has also channelled more than $5 million dollars to developing and/ or underdeveloped countries (Planvivio.org). The Mexico projects have issued 470,103 tCO2 offsets, which covers 2,437 smallholders and community groups on 9,645 hectare of land
A UK government commissioned report by the Carbon Trust has recognized Plan Vivo as one of only two land-use standards, and one of only four voluntary standards in total, which meets the 'valid' criteria in relation to verification, additionality, leakage, impermanence and double-counting of carbon credits. The FAO's Climate Smart Agriculture highlights the Plan Vivo project in Mozambique, Sofala Community Carbon, as a demonstration model how carbon sequestration through land use, land use change and forestry (LULUCF) can both promote sustainable rural livelihoods, as well as generate verifiable carbon emissions reductions for the international community. Moreover, Rainforest Alliance (2009) report identifies Plan Vivo as one of the two most suitable standards for certifying carbon projects involving smallholder coffee producers. Forum for the Future highlighted the Plan Vivo project, Scolel Te as an example of best practice in pro-poor carbon projects. Plan Vivo were recognised in the Eliasch review (reference) as contributing to climate change mitigation and poverty reduction. The Eliasch review is a comprehensive independent analysis, commissioned by the UK Prime Minister, of how international financing can be used to prevent forest loss.

Table 4. *Plan Vivo Registered and under process projects*

Project	Project Coordinator	Status
Scolel'Te, Mexico	AMBIO (http://www.ambio.org.mx/site/index.php?lang)	Registered Operational since 1997
Uganda	http://www.PlanVivo.org/projects/registeredprojects/trees-for-global-benefits-uganda/	Since 2004
Sofala Community Carbon, Mozambique	Envirotrade (http://www.envirotrade.co.uk/html/projects)	Registered since 2007 and Operational since 2003 Verifier: Rainforest Alliance
Emiti Nibwo Bulora, Tanzania	Vi Agroforestry (http://www.viskogen.se/English/Organisation)	Registered, operational since 2010
Limay Community Carbon, Nicaragua	Taking Root Nicaragua (http://www.takingroot.org/)	Registered since March 2011
NTFP-PFM, Ethiopia	Ethiopian Wetlands and Natural ResourceAssociation (EWNRA) http://wetlands.hud.ac.uk/)	PIN approved March 2010, validation expected 2011
Nyika and Mkuwazi Forest Conservation, Malawi	Malawi Environment Endowment Trust (http://www.meet.org.mw/)	PIN approved 2009 Validation suspended
Trees of Hope, Malawi	Clinton Hunter Development Initiative (http://www.clintonfoundation.org/what-we-do/clinton-development-initiative)	PIN approved 2008 Validation underway
Much Kanan K´aax, Mexico	U´yool´che A.C. (http://www.uyoolche.org/)	PIN approved June 2010 Validation expected 2011

Mikoko Pamoja, Kenya	TBC	PIN approved June 2010 Validation expected 2011
Community PES in the Congo Basin, Cameroon	Centre pour L'Environnement et le Développement (CED) (http://www.cedcameroun.org/)	PIN approved July 2010 Validation expected 2011
Hiniduma Biodiversity Corridor, Sri Lanka	Conservation Carbon Company (http://conservecarbon.org/)	PIN under review
Mongo wa Mono, Tanzania	Carbon Tanzania (http://www.carbontanzania.com/)	PIN approved March 2011
ArBolivia, Bolivia	SICIREC ArBolivia (http://www.sicirec.org/investments/sustainable-forestry-cochabamba)	Registered May 2011
Emiti Nibwo Bulora, Tanzania	Livelihoods & Forestry Programme (http://www.lfp.org.np/)	PIN approved March 2011

Plan Vivo claims that risk management is built into every stage of the planning and delivery process. The main Plan Vivo mechanisms to increase efficiency includes, strong approved technical specifications, monitored sale agreement, annual review and support of each project by Plan Vivo foundation, goal oriented participatory planning of projects, third-party verification every five years to ensure continued compliance with the standards, delivery of ecosystem services and strengthening of programme design (http://www.Plan Vivo.org). Plan Vivo registered and on pipeline projects are presented in table 4.

7.1 Major procedures and activities of Plan Vivo carbon offset projects

Monitoring

Plan Vivo has standardized project design, evaluation and monitoring systems and forms. The technical specification of each Plan Vivo project has detail prescription of the monitoring procedures. Procedures suppose to be easy-to-measure, have monitoring indicators and allow rapid and cost-effective monitoring by the technical team and community technicians. Each project of Plan Vivo is monitored annually by the regional experts. The annual monitoring reports describe performance of each project, failures and possible solutions (Plan Vivo Foundation, 2011).

Verification

About 10% of the activities of each Plan Vivo projects are verified by internal experts every year. Verification increases project credibility and reinforces the value of Plan Vivo certificates. It ensures Plan Vivo projects comply with Plan Vivo standards and identifying improvements required to ensure closer compliance with the standards. The verification process therefore provides greater certainty that ecosystem services are delivered and sustainable livelihoods are promoted. External verification of each Plan Vivo project is conducted every five years by an external verifier which is approved by the Plan Vivo

foundation. Organizations such as Rainforest Alliance and SGS have conducted the third party external verification for Plan Vivo emission reduction projects. In addition to the third party verification, Plan Vivo Foundation performs semi-external verification of Plan Vivo projects by requiring projects to provide the foundation with an annual report presenting advances, issues, monitoring results and general update amongst other. (http://www.Plan Vivo.org, personal communication with Plan Vivo expert).

Reporting

Plan Vivo provides public online information for each project. The main information include; location, coordinator, status, main activities, annual project reports and others. Moreover, Plan Vivo provides information about carbon credits called Plan Vivo Certificate . Plan Vivo has a unique serial number designed to preventing double selling. They can be traced back to the individual project and the date of issuance. All sales are published on the external registry platform Markit Environmental Registry http://www.markit.com/en/products/registry/markit-environmental-registry.page. The most important problems encountered by Plan Vivo are competitive carbon market, identifying buyers, reluctant producers who failed to implement the projects. To address this Plan Vivo has used e.g. U&W a Sweden-based consultant to link up several Plan Vivo projects with a range of purchasers of Plan Vivo Certificates (Plan Vivo Stakeholder meeting, 2011). Annual reports and personal communication confirms that 10-20% of producers are reluctant to implement the project according to the plan.

Reports are given regularly to the buyers in order to increase their trust and ensure clarity regarding the management of the resources. The information gives access to the general situation of the sales and the situation of each one of the buyers. These reports contain information on the quantities of carbon committed, quantities accredited, the time scale of the commitments, the regions where the carbon is coming from and purchasers of offsets (AMBIO, 2006).

Buffer

Plan Vivo claims that risk management is built into every stage of the planning and delivery process. To this end Plan Vivo uses a buffer approach as an additional risk management mechanism to ensure permanence. According to the Plan Vivo standard the total saleable carbon is determined by subtracting the percentage of carbon buffer. In addition if a proportion of the carbon stock is lost due to unforeseen circumstances such as extreme, drought, fire, disease, or a producer defaulting on their agreement, the carbon buffer ensures that the service paid for is still provided in full.

This approach was developed in response to concerns about the long-term viability of forest projects and the higher levels of risk perceived to be associated with carbon credits. Using a buffer approach not only ensures the value of carbon credits sold ex-ante, but also encourages developers to adapt strong risk management strategies. Currently, all Plan Vivo sequestration projects have a minimum of 10% risk buffer; 50% for avoided emissions projects. The level of risk buffer may vary, however, and will be reviewed annually by the Plan Vivo Foundation for each project based on information provided in annual reports. The appropriate risk buffer size will then be prescribed for the project as a whole, based on evidences from projects, technical specifications and advice from the external reviewers. In addition, Plan

Vivo has about 90,000 t CO2 collective buffer reserve (Plan Vivo Standards, 2008, Plan Vivo Foundation, 2011).

7.2 Cost-effectiveness estimates of Plan Vivo Projects

The Plan Vivo project development manual mainly focuses on technical design and implementation of the projects. It has neither identified cost estimation methods nor set cost estimation as a pre requisite for project approval. Consequently many Plan Vivo projects lack cost estimations. Moreover, Plan Vivo projects which have estimated costs have used different cost estimation methods. Some projects have considered opportunity and transaction costs in their cost estimation methods others have omitted both opportunity and transaction costs. Generally, most of Plan Vivo projects lack clear and detail cost estimations. However estimation of carbon sinks per ha and cost per ton of carbon are available and summarized in Figure 2 for some of Plan Vivo projects which have included these data in its project documents and/or technical specifications.

Table 5 shows an exploratory multi-criteria evaluation of some of the Plan Vivo projects. All projects in table 5 are either Plan Vivo registered or on pipeline. Scolel Té Mexico project is selected because they are pioneer project of Plan Vivo with good experience of carbon offsetting. Natural forest conservation "W. Ethiopia Plan Vivo" project is included as a competitive project because of its detail project documentation and for its low carbon price estimated during the establishment period (2 USD per tCO2) shown in the project document. Similarly, the Mozambique Fruit Orchard is selected because of its document quality and potential for both carbon sequestration and food production[3]. Risk and buffer rates shown in table 5 are collected from project documents (www.Plan Vivo.com). However, qualitative rates are assigned subjectively.

The cost estimation of Scolel Te carbon offsetting forest projects is published in De Jong et al. 2004 and Torres *et al.* 2010. The data comprise both the information registered by the project and generated by the model CO2Fix to estimate carbon stocks and fluxes in trees, soil, and wood products, as well as the financial costs and revenues and the carbon credits that can be earned under different accounting systems. Stocks, fluxes, costs, revenues and carbon credits are simulated at the hectare scale with time steps of one year (Schelhaas et al. 2004) sequestration stocks of biomass above and below ground, and products over a period of 100 years with rotation cycles of 25 years Sequestration options include practices on agricultural land in tropical and sub-tropical environments. The major plant species with which carbon offsetting cost is estimated in Mexico include: *Swietenia marcophylla* and *Cedrela odorata* are used in the former; and *Pinus oocarpa* and *Quercus* spp.

Tree densities are 130 trees/ha for live fences, 180 trees/ha for coffee under shade and 625 trees/ha for improved fallow systems. The cost of production of each plant is $0.19/plant and materials for protecting the plants account for $0.08/plant. The main factor affecting the implementation costs is labour. The default wage value used to estimate variable costs is $6 per day(De Jong et al. 2004). Based on Torres et al

[3] Improved coffee plantation, agroforestry or silvopastoral activities are also part of other Plan Vivo projects such s Scolol Té as this is a must for the producers as they can benefits from both activities

2010 cost curves for the Scolel Té projects, cost/ha and tco2/ha for figure 2 assumes a project size of 3,000 ha for agro-forestry type projects. The current carbon price structure from Scolel' Te Plan Vivo projects is listed in appendix 1.

The information for Mozambique orchard technical specification was taken from the project document at the Plan Vivo website. The assumption for this land use system is that more than 80% of the area is planted with cashew and the remaining area can be planted with other fruit trees. The objective of the project is to produce fruit in addition to carbon sequestration. Tree density is estimated to be 666 tree/ha. The whole site should be re-planted at year 50 and the life time of the project is 100 years (**www.Plan Vivo.com**).

For dispersed trees, in Mozabique, farm trees in Tanzania and woodlots in Uganda Plan Vivo projects are also included. These projects are included because they have an online documentation of cost estimations. The information for these projects is obtained from the project document of perspective projects from the Plan Vivo website.

The assumption for dispersed trees project in Mozambique is a density of 200 *Faidherbia albida* trees per hectare. Similarly farm tree planting project in Tanzania is estimated to be 200 trees ha with species such *as Markhamia lutea, Maesopsis eminii, Albizia lebbeck, Albizia coriara, Acacia polyacantha* and *Acacia nilotica*, agro-forestry species. For Uganda wood lot with native woody species the initial tree density is 310 trees/ha. A final 85% tree survival and a 15 to 60 years rotation period depending on the species planted is assumed. Main Species identified are *Milicia excelsis, Albizia spp., Maesopsis emnii, Markamia lutea, Grevillea robusta (silky oak), Cordia spp (Muzigangoma) and others.* The design of and plant species of these projects is more similar at a country level. Therefore, the comparison is more precise at country level than across countries. The detail design and specification of each carbon offset project can be obtained at **http://www.Plan Vivo.org/projects/registeredprojects/**.

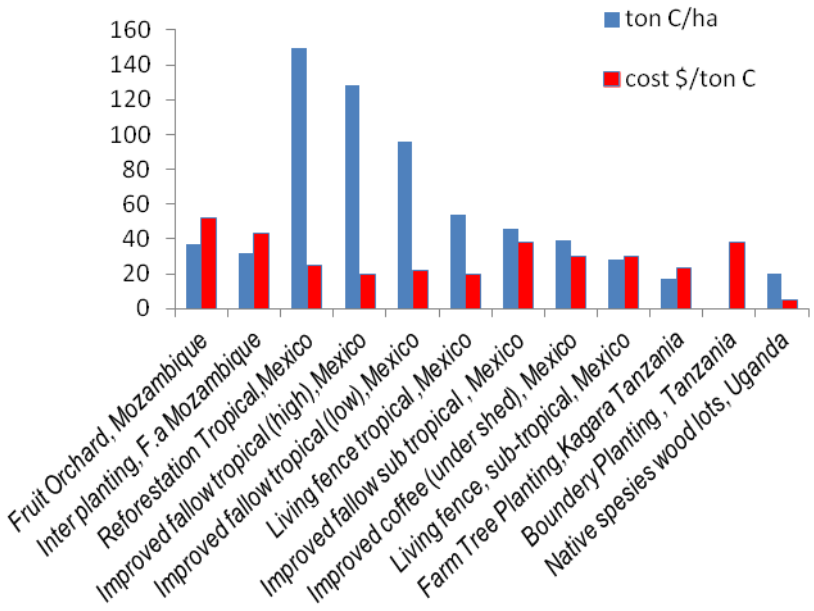

Figure 2 Carbon sinks per ha and cost per tonn of carbon of selected Plan Vivo projects

7.3 Multi-criteria project comparison of offset projects

Beyond cost-effecctiveness analysis, offset projects need to be compared across costs, carbon effectiveness and a number of co-benefits, and risk criteria. An example of this can be seen in comparing Plan Vivo projects in Mexico (Scolol Te), Ethiopia and Mozambique (Table 5).

Table.*5 Multi-criteria comparison of some of Plan Vivo projects*

Mexico Scolel Té Projects		
Criteria	Avoided/conservation	Sequestration
Price $/tCO2	5 (depends on the quantity purchased, on average last year we sold the unit at 6USD)	10(depends on the quantity purchased, on avergae last year we sold the unit at 6USD)
Risk (leakage + failure) average	32%	High
Buffer rate	50%	10%
Establishment cost	Low	High
Online document quality	Medium	Medium
Other competitive and alternative Projects		
Criteria	Natural forest , W. Ethiopia	Mozambique Fruit Orchard
Price $/ tCO2	2.00	Not known
Risk (leakage + failure) average	0.9%	High
Buffer rate	30%	High
Establishment cost	Low	High
Online document Quality	High	Medium

Sources: Project documents of respective projects (www.Plan Vivo.com).

Carbon price for Scolel' Te projects is obtained from the Ambio project coordination office.

In Table 5, leakage and buffer are values assigned by the Plan Vivo project designing group. The group assign values based on the past and existing experience deforestation, demand for wood and population pressure in general. Still these values are subjective estimations of the project designing experts. These figures may not necessarily determine the current price of carbon. They only show the optimum price of the carbon during the study period of the projects. The current market price is more dependent on current market for carbon. The reason why establishment cost of avoided carbon offsetting is low is that there are no many activities to demarcate natural forest as an avoided carbon offsetting project. The main activities to demarcate natural forest as carbon offsetting project are constructing fire breaks and assigning forest guards. Fire breaks are constructed if the probability of starting an artificial or a natural fire is high. However, to establish a sequestration projects a long list of activities are required. Activities such as nursery establishment and seedling production and planting demands high cost. Projects which have a complete document online have been scored the highest mark for online document quality. On the other hand projects which have only technical specifications online instead of full project document have scored medium for online document quality criteria.

Multi-criteria analysis (MCA) could be used to compare different alternatives across multiple criteria by assigning weights to the different criteria. Selection of criteria and assignment of weights is not a trivial exercise as they determine which alternative is preferred. A wider set of criteria for comparing alternatives could also be selected including other social, economic and environmental impacts. This falls outside the scope of this brief report.

8 Discussion

8.1 Certified carbon emission reductions (CERS) versus Verifiable carbon emission reductions (VERS)

Both CERS and VERS are playing a role in combating climate change by avoiding and sinking carbon from the atmosphere. Verifiable emission reductions VERs are more practical for project organizations such as FUNCiTREE and POLICMIX to buy credits from. The voluntary carbon market is more flexible and the price of the credits is affordable for individuals and organizations. The voluntary carbon market is an important competent of the compliance carbon market. The advantage of the voluntary carbon market over the compliance market is that, VER accommodates small projects, directly addressing and involving the community at grassroot level, is less bureaucratic and has a voluntary competitive force to expand the business. Voluntary participation also hasan ethical dimension that is absent from compliance based offsets of the Kyoto mechanism. In addition VER has created the opportunity for professionals, business oriented individuals and groups to engage with the carbon market. It has also paved the way for voluntary organizations and individuals to offset their carbon emissions voluntarily.

The compliance market with huge and top down organized structure may struggle to address such complicated challenges in a timely way. It suggests that VER and CER can work more efficiently if they advance their specialization in different areas. The specialization can be also on the size of projects. The compliance market can specialize on big projects and the voluntary market can focus on small scale and private organizations. The current trend shows that the compliance market is focusing on huge projects and at national level. But, the voluntary market is working with relatively small private organizations and non-governmental organizations. That is why VER is the best and most appropriate carbon offsetting schemes for FUNCiTREE and POLICIMIX to buy projects from.

On the other hand, CER can exhibits a better accuracy in following standards, technical specifications and regulations of carbon offsetting. Moreover, CER has better organized and centralized working system. As a result, CER has better opportunity to modify or generate standards, specifications and regulations based on feed backs. Moreover, CER has the opportunity to utilize more of power of law than power of market. The compliance market has the opportunity to press parties and implement the Kyoto protocol where by huge amount of carbon market can be created. CER has been implementing mainly energy sectors such as hydro and wind power. These areas of carbon credits are more appropriate for the compliance market.

8.2 Sequestration versus avoided emission offsets

Avoided emissions

Demarcating forests as a carbon offset project (for avoided emissions) is an economic and less complicated activity compared to establishing sequestration forests. It involves low establishment cost. In addition, the ecosystem service provision can be very high. It contributes to conservation of biodiversity and can be important for, for instance, watershed protection, water flow control and the maintenance of

soil fertility. It can also serve as a tourist attraction site by increasing the aesthetic value of the area. It has an immediate impact in stabilizing the local climate compared to establishing new forest. It does not compete with current agricultural sector for land (although it does compete with future landuse due to agricultural expansion). Instead it contributes for the productivity of the nearby agricultural land by stabilizing the local climate and water flow.

Uncontrolled fires and illegal cutting are the main risks of avoided emission carbon offsets. In areas where there is high population pressure, the demand for wood is high. Consequently, it can be a huge challenge to impede illegal cutting from the avoided-emission projects. However, if the energy demand is fulfilled by other energy sources such as hydro power and wind power the challenge can be minimized. The demand for construction wood can also be substituted by bricks and other construction materials. The need for governance is an important factor. In order to avoid mass release of carbon to the atmosphere, forest fires should be avoided from the carbon offsetting projects. To minimize the risk of both natural and artificial uncontrolled fire properly designed fire breaks need to be established. A forest fire brigade is also necessary in areas where forest fires are common.

Sequestration

Establishing sequestration carbon offsets stimulates the local economic activity. Seed collection; establish forest nurseries, growing and planting seedlings create job opportunities for the local people. It can increase food production in case of agro-forestry practices. It fixes carbon from the atmosphere and increases the forest cover of the area.

In agrarian communities the competition for land is high in many places. Therefore, it can be a challenge to get land to establish carbon sequestration projects. Moreover, survival rate of seedlings is low particularly in areas where moisture is a limitation. As a result, it may be necessary to replant. Generally, sequestration projects involve high establishment costs. However, utilizing marginal lands for carbon offsetting projects can be a possibility. In addition growing less wood and fodder value, but more efficient carbon sinking plant species is another possibility. Agro-forestry practices can also minimize the competition for land while increasing food and forage production. Rural communities need fuel and other tree products (materials), and planting of trees can provide the communities with these products in a sustainable manner.

8.3 Plan Vivo versus other VER

This report focuses on Plan Vivo VERS. There are several reasons for this focus in the context of offsetting POLICYMIX and FUNCiTREE carbon emissions. Plan Vivo mainly works with forest and related activities. Plan Vivo also works only in the Voluntary market. It addresses individuals at grass root level. Plan Vivo has flexible carbon price and procedures which can accommodate the interest of individuals and small organization to buy credits from. Other organizations for example CDM and Gold standard mainly work with hydro and solar energy projects.

Plan Vivo has developed standards, technical specifications, monitoring and reporting system. Moreover, Plan Vivo has availed project documents and other important information online. Plan Vivo is expanding its area coverage to Africa and to other countries of South America from its birthplace, Mexico. The Plan Vivo Ecotrust Uganda project, for example, is an excellent example of a Plan Vivo project in Africa. This project has complete and transparent annual reports and third part verification reports (**www.Plan Vivo.org/wp-content/uploads/Ecotrust-Uganda-PV-valid-assess-09.pdf**

Both registered and on pipeline projects of Plan Vivo have included key conservation sites and agro-forestry, afforestation and reforestation schemes. Agro-forestry carbon offsetting schemes have been implemented at local, individual and small scale level under Plan Vivo. It presents the possibility of addressing millions of poor people through Plan Vivo and other similar organizations. The avoided Plan Vivo projects have included key natural vegetation conservation areas in both South America and Africa. Such sites are the most important areas in conserving indigenous plant species, wild animals and water catchments.

Moreover, Plan Vivo is trying to connect potential carbon credit purchasers and forest projects. The activity can encourage voluntary individuals and organizations to offset their carbon emissions. Owners of forest projects can sell their carbon stock and use the money to maintain the forest and cover some of their expenses. Purchasers can experience carbon offsetting, benefit from carbon neutral trademarks and can develop a sense of ownership of the project. Plan Vivo has recruited carbon retailers such as U&W, Blue Green Carbon and Climate Action. However, Plan Vivo still needs to advance some certifying, reporting, verifying and other activities based on feedbacks and experiences. Most of the Plan Vivo projects lack cost estimation. Detailed cost-benefit analysis of the project is an important tool to increase the confidence of donors, producers and purchasers. It also helps to attach value to projects by different stakeholders. In addition, most of the Plan Vivo project documents lack sections which show additional benefits in monetary terms, particularly in the case of avoided emissions. The Plan Vivo guidelines therefore need to update standards and technical specifications based on the feedbacks from each project. Active participation of governmental structures at different levels needs to be advanced. The participation of governmental institutions such as the departments of environment of the respective countries can increase cost-effectiveness of VER projects. They can share the cost of document preparation, verification, monitoring, and awareness creation among producers and potential carbon offset purchasers. Generally, Plan Vivo projects as pre-REDD+ projects need to keep rigor design, data collection, and analysis methods for understanding the impacts (Caplow et al. 2011). On the other hand REDD+ projects should fully exploit the experience of pre REDD+ projects such as Plan Vivo projects.

9 Concluding Remarks

9.1 Avoided Emission Reduction versus Carbon Sequestration Forest projects

Avoided emissions are less expensive offsetting schemes compared to establishing new sequestration carbon offsetting projects. Avoided emissions carbon offsetting projects have additional benefits such as watershed and biodiversity conservation. Uncontrolled fire, illegal cutting and leakage are most important concerns for avoided carbon emissions offsetting projects.

Sequestration projects can increase forest cover and capture carbon from the atmosphere. They have less risk of leakage and higher probability of additionality. However, they have long gestation periods and higher risk of failure due to drought, pest, disease and animal damage. Sequestration is more complicated activity compared to avoided emissions. Carbon sequestration with agro-forestry systems can also contribute to increase food and fodder production, and of materials and other tree products. Sequestration carbon offsets can also play great role in stimulating the local economy. They create more job opportunities for the local people than avoided carbon emissions offsetting projects do.

9.2 Verifiable emission reductions (VERS) and Certified Emission Reductions (CERS)

VER and CER follow nearly analogous methods and standards. Yet, they address different group of customers and focus on different types of projects. CERS focus on big and governmental carbon offsetting projects. Only a small number of sectors and only a few counties are covered by the mandatory cap and trade system of CDM. Most of the CDM CERS are concentrated in China. While the voluntary market focus on small scale, private and non- governmental organizations mostly in alternative energy, such as wind and solar energy. Plan Vivo mainly works on small scale community forest-related projects of interest to the FUNCiTREE and POLICYMIX projects research interests.

9.3 Costs effectiveness of carbon offsetting projects

Most of the cost studies of carbon offsets have considered only partial costs and benefits. Both cost-benefit analysis or environmental valuation and cost curves can provide better information on cost effectiveness of carbon offsetting forest projects. The magnitude of costs per ton of carbon varies from country to country and sequestration and avoided emission (conservation systems) and other many more factors. Economies of scale and opportunity costs significantly affect cost effectiveness of carbon mitigation. Live fences and coffee under shade are among the most cost-effective carbon offsetting projects. Generally, avoided emissions are less costly than sequestration carbon offsetting projects.

9.4 Why Plan Vivo and why the Scolol Té project in Mexico?

The main factors which make Plan Vivo VERS different from other VERS include; Plan Vivo's focus on forests; working only with the voluntary carbon market; a long experience in carbon offsetting. In addition, Plan Vivo has collaboration with research and documentation of costs. A number of articles has been published on performance and cost effectiveness of Plan Vivo projects. Most of the Plan Vivo projects have online documents which show the detail planning, reporting and verification procedures. Plan Vivo as a principle considers both the ecosystem and livelihood at a household level.
The Scolel Té, Plan Vivo carbon offsetting project is a pioneer carbon offsetting forest project with a good experience of carbon credit marketing.

Plan Vivo makes no initial distinction in its price structure between avoided offsetting and sequestration projects. Moreover, it is an open question whether avoided carbon emissions or sequestered carbon offsets are more sustainable across multiple criteria. Avoided deforestation/forest conservation offsets versus sequestration projects is a question of how biodiversity conservation advantages of conservation are weighed against social-economic advantages of sequestration projects. The data available in project documentation provides no clear guidance on alternatives that should be better in absolute terms. POLICYMIX and FUNCiTREE partners selection of offsetting projects - conservation versus afforestation, reforestation and agro-forestry – will have to be based on preferences on the relative importance of social-economic and biodiversity conservation benefits versus effectiveness of carbon sequestration versus avoided emissions. We hope this brief has provided further information to make a more informed choice.

Glossary and Abbreviations

Active credits (Plan Vivo): Credits which are purchased for reselling purposes and it does not retired on the purchaser's name

Additionality: new carbon activity that must be measured as an addition to a business as usual baseline

Avoided emissions: emissions that are not produced (are avoided) by using non-emitting technologies

Baseline emissions: reference point from which the carbon benefits of project activities can be measured.

Buffer: Carbon stock reserved to compensate shortage of carbon in case of project failure, based on a risk assessment.

Carbon pool: a reservoir with the capacity to store and release carbon, such as soil, terrestrial vegetation, the ocean,and the atmosphere

Carbon sequestration: direct removal of carbon dioxide from the atmosphere through land use change, afforestation, reforestation and/or increases in soil carbon (biological sequestration only)

CER: Certified emission reduction (CER), a Kyoto Protocol unit equal to 1 metric tonne of co2 equivalent. It includes temporary certified emission reduction (tCERS) and long term certified emission reductions (lCERS).

ESCROW account (Plan Vivo): It is a type of account in which the buyer's contract deposit is held in until closing or until the process is complete.

Emissions trading: One of the three Kyoto mechanisms, by which parties may transfer Kyoto Protocol units to, or acquire units from, another party. The other two mechanisms are...

EU-ETS: European Union Emissions Trading Scheme

Land use, land-use change, and forestry (LULUCF): An agreement referring to greenhouse gas emissions and removals resulting from direct human-induced land use, land-use change and forestry activities.

Leakage: an increase in carbon emissions or a reduction in carbon sequestration outside the boundaries of a project as a direct impact of the project.

Mitigation: Implementing activities or policies to reduce green house gas emissions and/or enhance carbon sinks.

REDD: Reducing Emissions from Deforestation and Degradation. REDD+ is a modification and address both emission reduction and carbon sequestration through forest rehabilitation, conservation and restoration.

UNFCCC: United Nations Framework Convention on Climate Change

VCS: Voluntary Carbon Standard

VER: Voluntary Emissions Reductions – emission reductions made where there is no legal obligation.

Vintage (of Plan Vivo carbon credits): It is the section of the carbon credits registration database which refers to year and place of production of carbon credits

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Appendices

Appendix 1. Plan Vivo carbon offset prices

Information on price structure of carbon obtained from Plan Vivo, Scolel Te.
Date: Tue, 23 Aug 2011

Table A1

Volume (tCO2)	Price/t
0-500	10
501-800	9
801- 1,500	8
1,501 - 5,500	7
5,501-10,500	6
10,501 – 20,500	5
20,501+	4.5

Note:
for the credits at 5USD, at least 25% of the carbon needs to be allocated in REDD
for the credits at 4.5USD, at least 50% of the carbon needs to be allocated in REDD

Appendix 2. Example contract for Plan Vivo Forest management contract

AGREEMENT FOR THE SALE AND PURCHASE OF PLAN VIVO CERTIFICATES FROM AFFORESTATION, REFORESTATION OR AGRO-FORESTRY FOREST ACTIVITIES GENERATING CARBON CREDITS BY AVOIDING DEFOREATATION (CONSERVATION) THROUGH THE SCOLEL'TE PROJECT, MEXICO

'Plan Vivo Certificates' are environmental service certificates, independently issued by the Plan Vivo Foundation in accordance with the Plan Vivo System. Each Certificate represents the avoidance of one tonne of carbon dioxide (tCO_2) plus additional ecosystem and livelihood benefits.

The Scolel Té project is a sustainable land-use project coordinated by AMBIO, a Mexican Cooperative, located in the Chiapas and Oaxaca districts of Mexico. Scolel Te generates Plan Vivo Certificates through community-led forest management (forest conservation activities generating avoided emissions Plan Vivo Certificates), afforestation, reforestation and agroforestry activities.

Prior to signing this agreement, the buyer shall specify to the seller whether or not payment will go through the Plan Vivo ESCROW account and whether or not the Plan Vivo Certificates will be active credits (for reselling purposes). If not specified, the Plan Vivo Certificates will be retired on the purchaser's name

1. THE PARTIES:

'The Seller' is the Fondo Bioclimatico of Cuitlahuac #30, Barrio de La Merced, San Cristóbal de las Casas, Chiapas, México C.P. 29240. The Seller is a not-for-profit trust fund established to administer ecosystem services provided by the Scolel Té project.

'The Buyer' is represented by XXX on behalf of X, with a registered office at XXX

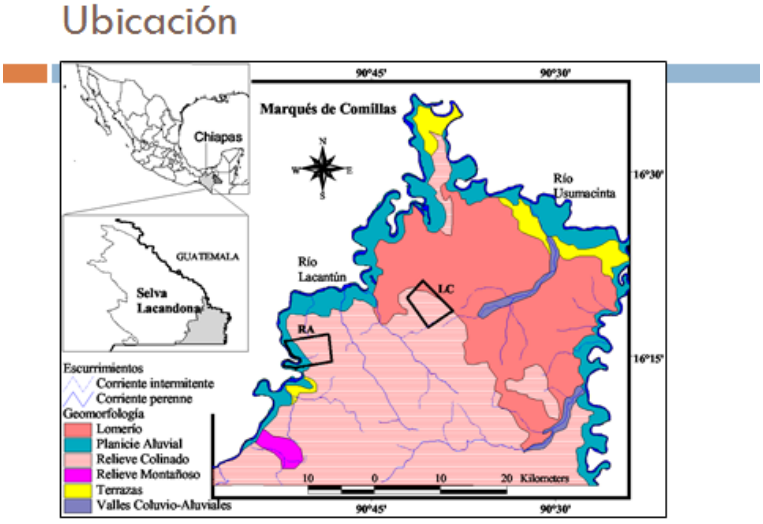
2. KEY TERMS:

Payment method: Direct to the project

Type of Credits: Credits which retire on the purchaser's name

Type of offsetting activity: Forest management - AFM-ST08-01

Information on the forest (see map below).



3. KEY TERMS: SALE AND PURCHASE

Fondo Bioclimatico agrees to sell and XXXX agrees to buy Plan Vivo Certificates in the amount of 190 t/CO_2 for the consideration of USD$ XXXX (USD$XX.XX per tonne) upon the terms and conditions contained in this agreement and according to the following schedule:

Quantity of Plan Vivo Certificates	XXXX
Unit price per Certificate	USD$XX.XX per Plan Vivo Certificate
Total payment due	USD$
Vintage	2010
Delivery Date	November 2011

4. Baseline methodology

Methodologies approved by the Plan Vivo Foundation and BR&D as applicable to the project activities carried out in accordance with the Plan Vivo Technical Specification Standard. The technical specifications relevant to the project are:
Forest management - AFM-ST08-01
http://www.Plan Vivo.org/?page_id=49

5. Third party verification of compliance will be carried out by Rainforest Alliance through their Smartwood programme, email: XXXXX

By signing below, the parties enter into a sale and purchase agreement for the above volume and price of Plan Vivo Certificates, type of offsets and on the following terms and conditions ('the Agreement')

SIGNED

On behalf of Fondo Bioclimatico

Signature:

Print name:

Position: Legal representative

Address: Calle Cuitlahuac num 30, barrio la Merced. 29240 San Cristobal de las Casas, Chipas, Mexico

On behalf of XXXX

Signature:

Print name:

Position:

Coordinator:

DEFINITIONS:

In this agreement:

The 'Plan Vivo Foundation' is the organisation that issues Plan Vivo Certificates and oversees Plan Vivo projects.

'Plan Vivo Registry' means the on-line register of all issued Plan vivo Certificates.

'Plan Vivo Standards' – The Standards used in Plan Vivo project design and implementation and the administrative and reporting practices that are in place.

PAYMENT AND DELIVERY

The Buyer agrees to make payments to the Seller within 30 days of receipt of an invoice. [Payment will be made into the specifiy account to be used - ESCROW/no ESCROW, whose bank details are laid out in Schedule i of this agreement].

Delivery of Certificates shall be deemed to be completed upon the Buyer's receipt of the Certificates and the recording of this in the Plan Vivo Registry ("Delivery").

Seller shall use its best efforts to ensure the total volume is delivered by the delivery date. In the event that, despite its best efforts, it is not possible for the Seller to generate the total volume by the delivery date, then:

The Seller shall notify the Buyer of any anticipated delivery shortfall and provide an explanation of the reasons

The Seller shall notify the Buyer if Seller anticipates being able to Deliver the shortfall volume in a subsequent project cycle and, if so, include details of the proposed deferred delivery date

Where the Seller notifies the Buyer of proposed deferred delivery, then the Buyer shall have the right but not the obligation to accept such deferred delivery and shall notify Seller in writing of its decision.

If Buyer rejects deferred delivery, then Buyer shall be refunded any amount against which there has been no corresponding delivery

TRANSFER OF TITLE

All rights and legal title to the Plan Vivo Certificates purchased under this Agreement will be transferred to Buyer upon Delivery. The transaction shall not imply the transfer of any rights of ownership over the land, timber or agricultural products where the project activities will take place.

WARRANTIES

The Seller warrants to [buyer] that, on the date of signing:

It is authorized to sell Plan Vivo Certificates by the Plan Vivo Foundation.

The Certificates in this agreement are not subject to any claim, encumbrance or action by any person or entity other than the Buyer.

The land use activities in the Scolel Té project used to produce the carbon credits will be forest management for conservation.

Seller is not bankrupt, and there are no proceedings pending or being contemplated by it or, to its knowledge, threatened against it which would result in it being or becoming bankrupt. Seller expressly disclaims and other representations or warranties.

The Buyer warrants to the Seller that, on the date of signing:

There is no pending or (to Buyer's knowledge) threatened litigation or administrative proceeding that materially adversely affects Buyer's ability to perform its obligations under this Agreement.

Buyer is not bankrupt, and there are no proceedings pending or being contemplated by either of them or, to their knowledge, threatened against them that would result in them being or becoming bankrupt.

At the time of payment, Buyer has all necessary funds for purchasing of Certificates under the Agreement.

Buyer expressly disclaims and other representations or warranties.

GENERAL:

Assignment. The rights and obligations created under this Agreement may not be assigned by either party without prior written consent.

Amendment. This Agreement may not be amended or altered unless agreed in writing and signed by the Parties.

Taxes and Fees. Seller is responsible for all taxes and fees arising in Mexico and all taxes and fees arising prior to delivery of the Certificates to Buyer. Buyer is responsible for all taxes and fees arising at or after delivery of the Certificates.

Governing Law. This Agreement shall be governed by the Mexican law (Código Civil Federal en su artículo 1794)

Notices. Except as expressly stated to the contrary, all notices and other communications required or permitted to be given under this Agreement shall be in writing and shall be delivered or transmitted to the intended recipient's address as specified above or such other address as either party may notify to the other for this purpose from time to time.

Severability. If any term of this Agreement is found to be illegal, invalid or unenforceable under any applicable law, such terms shall, insofar as it severable from the remaining terms be deemed omitted from this Agreement and shall in no way affect the legality, validity or enforceability of its remaining terms.

NON EXCLUSIVITY:

This agreement does not prevent the Seller or buyer from undertaking or developing collaborative arrangements with other parties in respect to other transactions or business.

DURATION:

This agreement shall come into force upon the date of signature and shall continue in force until Plan Vivo Certificates are issued to the Buyer in the amount specified above.

AMENDMENTS:

This Agreement may be modified or amended by written mutual consent of the parties. Consent is not to be unreasonably with held or delayed.

NON-DISCLOSURE:

The parties agree that the information contained herein is sensitive commercial information and that such information, including the existence of this Agreement, will not be imparted to a third party except upon the written mutual consent of both parties or as otherwise may be required by law. Consent is not to be unreasonably withheld or delayed

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