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Fiddling With Soil Carbon Markets While Africa Burns...

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Introduction: Agriculture, Climate Change and Carbon Markets

Climate change poses enormous challenges to agriculture and smallholder farmers. Increasing average temperatures; extreme events that include heat waves, floods and drought; alterations in rainfall patterns – all will combine to make growing food a more risky endeavor for farmers in both developed and developing countries. These risks will fall hardest on the most vulnerable, namely smallholder farmers living in poor countries.

Adaptation to climate change is becoming a central concern of farmers, scientists, policymakers and politicians. Substantial resources and energy will be required to produce adequate food supplies in the face of climate change. The climate crisis comes at a time when agriculture around the world is recovering from decades of neglect. The consequences of this neglect came into sharp focus during the food crisis of 2007-2008 as millions of additional people across the globe fell into poverty and the number of people suffering from hunger passed one billion.

To address both the need for more finance for agriculture and the climate crisis, the World Bank and the Food and Agriculture Organisation (FAO), among others, are promoting selling of carbon offset credits based on the carbon that can be stored in soil. We refer to this mechanism as soil carbon credits.[1] The idea is that farmers would utilise agricultural practices, such as incorporating compost and manures in their fields, to maximise the carbon stored ("sequestered") in soil.

The logic is that if the stored soil carbon can be measured and valued, it can then be sold and traded on the market. Credits would be bought by companies or individuals to offset their own greenhouse gas emissions. Alternatively, credits would be bought by investors who would trade the credits in similar ways to commodities such as wheat or tin, speculating on whether the price of carbon credits would increase or decrease.

The World Bank argues that through the creation of a market for soil carbon credits small-farm productivity will increase and private sector investment will be mobilised for the agriculture sector (Woelcke and Tennigkeit, 2010).
In this report we examine critically the basic assumptions of the World Bank:

- that soil carbon will be valued as a commodity
- that soil carbon can be measured accurately enough to tempt investors
- that smallholders will benefit from the trade in soil carbon
- that a private market in soil carbon is an effective means to mobilise the resources needed to address the impacts of climate change on smallholder agriculture
- that smallholder farmers should bear the mitigation burden of the developed countries in their soils.

1. A **carbon offset** is a *reduction* in emissions of carbon dioxide or other greenhouse gas, or *sequestration* of gases already emitted, which are made in one location in order to compensate for or to **offset** an emission made elsewhere. Offsets that are bought and sold are often called credits. This indicates that the purchaser is receiving credit for emission reduction or sequestration in one location that entitles them to emit the same amount of greenhouse gas in some other location.

i. There is no soil carbon market

The first rule of a market is that they need sellers and buyers. A soil carbon market requires international rules that give incentives to polluters and investors to buy carbon credits. However, there is a strong possibility that world governments will allow key provisions of the Kyoto Protocol to lapse after 2012, undermining its market mechanisms. Moreover developed countries' extremely weak emission reduction commitments will mean that there is little global demand for carbon credits.

Two types of markets currently exist for trading of carbon offset credits: *voluntary* and *compliance* (also called *regulatory*). The *voluntary* market, described in Box 1 and in section II, is where individuals and companies that want to offset their own carbon usage purchase offset credits in the absence of legal requirements.

The *compliance* market exists where there are laws mandating emission reductions and where those laws also allow regulated entities to offset some of their emissions by paying someone somewhere else to reduce emissions for them. The Kyoto Protocol creates a global compliance market by putting a legally binding cap on emissions of developed countries, whilst establishing two mechanisms to create offset opportunities in economies in transition and in developing countries. The two mechanisms are Joint Implementation and the Clean Development Mechanism (CDM). Neither mechanism accommodates credits generated through soil carbon sequestration.

Compliance markets have also been established at regional, national, and sub-national levels. These markets function in a similar way to the global market. National or sub-national governments enforce legally binding caps on emissions from regulated entities such as power plants and manufacturing facilities. The ceilings are gradually reduced over time, meaning that companies must either find ways to reduce their emissions or offset some percentage of their required emission reductions by buying credits. Usually only a set percentage of emission reductions can be offset, with the percentage established by law in each system.

The European Emissions Trading Scheme (EU-ETS) is the oldest and most prominent of the non-Kyoto compliance markets. Markets are also being established in a handful of countries, such as Australia, New Zealand and China. Markets in sub-national jurisdictions such as the US state of California and the Australian state of New South Wales are also developing, following the lead of the first sub-national market in the Canadian province of Alberta.

The EU-ETS does not allow trading of soil carbon credits. The compliance market in Alberta, Canada, is the only place where soil carbon offsets have been marketed. However, regulated entities in that market can only buy offset credits from projects in Alberta (Hamilton et al, 2010).

The proponents of a compliance market for agricultural soil carbon includ the International Food Policy Research Institute (IFPRI) and the Africa Biocarbon Initiative. Both have been arguing strongly to change the rules for the CDM and the EU-ETS to allow soil carbon credits to be traded as offsets within those mechanisms. That might eventually happen, although knowledgeable observers consider this unlikely before 2015 in the case of the CDM and 2020 in the case of the EU-ETS (Dooley, 2011).

Currently the state of the compliance markets is dismal. The markets are characterised by an oversupply of credits and low demand. The value of traded CDM credits (known as Certified Emissions Reductions, or CERs) fell to US$18.3 billion in 2010, from a high in 2008 of US$26.3 billion. In the turmoil on world financial markets in August 2011, carbon credits fell close to their near all-time lows, at €10.65 per tonne for EU-ETS credits and €7.4 per tonne for CERs (Wynn and Chestney, 2011).

Even more problematic for the proponents of soil carbon as a compliance offset is the strong possibility that countries will not agree to a second commitment period for the Kyoto Protocol when the first period expires in December 2012. The cap on developed country emissions established under the Protocol is for a commitment period lasting from 2008 to 2012. Negotiations are continuing to establish a second commitment period, but three large countries – Russia, Japan and Canada – are currently refusing to be legally bound by an emission reduction requirement. The United States never adopted the Kyoto Protocol, and will not join a second commitment period under this regime.

A final blow to the compliance market would be a post-2012 system based on voluntary pledges combined with large loopholes. This would mean that developed countries would not have emission reductions of sufficient magnitude or a legally binding nature to necessitate offset options (Kartha, 2011).

Without a legal cap on emissions there is no mechanism to generate sufficient demand for compliance offsets in a market that is already oversaturated. Regardless of how much effort the World Bank and other proponents of soil carbon compliance offsets put into creating those carbon credits, without buyers needing offsets or regulatory systems that allow soil carbon credits to be traded, there is no market for soil carbon.

Box 1: The voluntary carbon market and soil carbon

The voluntary market is used by those who want to purchase carbon credits to offset their emissions, whether out of personal conviction or in an effort to project an environmentally responsible image. For example, companies wanting a green image may try to offset their entire emissions every year in order to claim carbon neutrality. Buyers are principally located in the United States (49%) and Europe (41%) (Hamilton et al, 2010).

The voluntary market is a fraction of the size of the compliance markets. In 2009, 93.7 million tonnes of carbon were traded on the voluntary market, less than one percent of the volume of the compliance markets, and 26% less volume than was traded on the voluntary market in 2008. The market value of the credits traded on the voluntary market decreased 47% to US$387 million in 2009. Meanwhile in the same year the compliance markets grew 7%, trading over 8 billion metric tonnes, valued at US$144 billion (Hamilton et al, 2010).

Soil carbon credits made up 3% of the credits traded on the voluntary market in 2009, up from 0.5% in 2008. The average price for these credits was US$1.20 per tonne.

In 2005, the Chicago Climate Exchange (CCX) began trading credits generated by US farmers using no-till practices. All the soil carbon credits traded on the voluntary market in 2009 were verified by the CCX. Due to the precipitous fall in soil carbon prices on the CCX (to US$0.10 per tonne) and the subsequent closure of the exchange in 2010, major farmer organisations responsible for the bulk of those credits have announced they will no longer be offering credits on the market. This is likely to reduce to near zero the share of agricultural soil carbon on the voluntary market (North Dakota National Farmers Union Carbon Credit Program, http://carboncredit.ndfu.org/).

ii. Voluntary soil carbon credits will not provide significant or secure finance

In the absence of a compliance market outlet for soil carbon credits in the near future, the World Bank and other market proponents currently put their faith in the potential of voluntary markets to generate significant revenues for agricultural development. However while there may be considerable technical potential for soils to sequester carbon, there is not parallel potential to sell soil carbon credits on voluntary markets. Scientific uncertainty about the quantification and verification of soil carbon, as well as the non-permanence of sequestered carbon, put both the value of the associated credits and the mitigation potential of soil carbon markets in doubt.

The biological nature of the soil carbon system, in particular the constant cycling of carbon into and out of soils through natural processes, presents a challenge for the proponents of carbon credits.

Carbon credits, as a commodity bought and sold in a financial market, have a value based on an underlying asset, namely the amount of carbon that is, theoretically at least, not released into the atmosphere to begin with, or is taken out of the atmosphere. For example, emissions averted by the construction of a solar power plant can be quantified in terms of the carbon dioxide that is not emitted by the coal-fired power plant that it replaced. Emissions that are prevented are termed avoided emissions. Because they have been avoided, they are permanent emission reductions.

Soil (or tree) carbon is different. Soils (or trees) act as a carbon sink, meaning that they trap, or sequester, carbon already in the atmosphere. Therefore, soil carbon does not prevent new emissions, but instead sequesters existing emissions. However, because this carbon can easily react with oxygen and re-enter the atmosphere as carbon dioxide, credits based on soil carbon are worth much less than credits from avoided emissions. For example, the average price in 2010 of solar energy credits was US$33.80 per tonne while agricultural soil credits were trading at US$1.20 per tonne. At the end of 2010, before the ultimate collapse of the CCX, soil carbon credits were trading for US$0.10/tonne (Hamilton et al, 2010).

What are the characteristics that give value to carbon as a commodity? Or conversely, what do we know about soil carbon that explains the major discrepancy in pricing and general undesirability of investment in agricultural soil carbon noted in the previous paragraph? We briefly discuss here four components of the low value of soil carbon: uncertainty in measurement; non-permanence; diminishing returns over time; and low per-hectare storage rates leading to large transaction costs.

Measurement uncertainty. Soil carbon, like forest carbon, cannot be measured with the precision necessary for commodity investors. The Munden Project (2011) undertook an analysis of the market for carbon from Reducing Emissions from Deforestation and Forest Degradation projects and the suitability of forest carbon as a commodity. Their conclusions can easily be applied to soil carbon: "*From a trading point of view, the process [by] which forest creates carbon is ill defined to the point of being unacceptably risky. It contains a vague, poorly defined and scientifically unreliable process for creating forest carbon.*" Having different measurement methods and data availability from project to project means there is no standard definition of the commodity. "*As a consequence, pushing these commodities through the derivatives trading framework will prove impossible*" (The Munden Project, 2011).

The rate of soil carbon sequestration varies according to soil characteristics, seasons, precipitation, human intervention and climate change. Any change in farming practices means that carbon sequestered today may not be in the soil tomorrow.

Non-permanence. To have value for an investor who buys a credit for a tonne of carbon – whether sequestered or as avoided emissions – that credit must have value over the length of time the investor owns that commodity. Credits for biological carbon – carbon temporarily stored in trees or in the soil – tend to be worth much less than credits for avoided emissions, such as for practices that reduce or eliminate use of synthetic fertilisers and practices which avoid completely the production of nitrous oxides associated with fertiliser production and use.

Diminishing returns over time. Eventually soils become saturated with carbon and no more carbon can be stored. Scientists are still researching this process but the average amount of time before saturation happens is estimated at 20-25 years (Sanderman et al, 2011).

Low per-hectare storage. Many policy analyses assume that 1 tonne or more per hectare per year can be sequestered on a steady and long-term basis. However, this assumption finds little support in the scientific literature.

The amount of soil carbon sequestration depends on several factors such as soil texture, profile characteristics, climate, and management practices. Studies suggest that the amount can range from 0 tonne in dry and warm regions up to 1 tonne in humid and cool climates.

How might developers of the soil carbon market and project proponents choose to address problems of uncertainty, low value and high transaction costs as they move forward with market construction and credit sales? There are several options according to The Munden Project (2011):

- Massively discount, so that only a small fraction of the carbon stored is actually sold. Discounting would, however, obviously significantly reduce the amount of money invested in the project and hence available for agricultural development. (See Box 2 on the Kenya Agricultural Carbon Project for an example of discounting.)
- Rig the measurement methodology to produce artificially high numbers of credits, such as by inflating yearly carbon accumulation rates. (See Box 2 for an example of overestimation of yearly rates of accumulation.)
- Choose the easiest accounting method, regardless of scientific accuracy, to reduce costs. (See Box 2 for an example of use of proxy indicators instead of actual measurement of soil carbon.)

iii. If there are revenues from the market, they will not reach smallholder farmers

To measure, report and verify soil carbon will require substantial resources for remote sensing technologies, field measurements, and development of modelling approaches to understand soil carbon fluxes. Smallholder farmers will not carry out this work. Instead, project developers and technicians will need to invest significant resources in these tasks. Given the small amount of money that soil carbon would likely attract from a private market for all the reasons outlined in the previous section, it is likely that the most of the revenue will go to the technicians, not farmers.

If a soil carbon market is developed, the profits earned in that market will not be distributed evenly. "*Experience within numerous commodities markets shows a generalized pattern whereby commodity producers receive an extremely limited percentage of the final commodity cost*" (The Munden Project, 2011). Most of the revenue generated will go to intermediaries, aggregators, and technicians paid to measure soil carbon, with little or no revenue going to farmers themselves. Smallholders and women farmers are likely to be disproportionately disadvantaged.

Soil carbon sequestration credits are unlikely to generate revenues for smallholders because:

- *Farm soils cannot sequester much carbon in a year.* Even if a farmer can sequester a half tonne per hectare in a year, and owns one hectare of land, there is little money to be made. This is particularly so if that soil carbon must be discounted and a significant fraction of the revenue will go to the project developer, technicians and other intermediaries. For example, if a tonne of carbon is worth US$2 on the voluntary market, this is discounted by 60% to address issues of impermanence, and 40% of the gain goes to intermediaries, the farmer will make around US$0.25 per year. (See also Box 2 on the Kenya Agricultural Carbon project), As stated by consultants involved in designing the soil carbon market: "*The principle direct benefit to farmers will be higher agricultural yields, not [emphasis in the original] direct carbon payments*" (Forest Trends et al, 2010).

- *Transactions costs are extremely high.* Establishment costs can be significant. The FAO estimates that adoption costs for practices that increase soil carbon storage range from US$12-600 per hectare (FAO, 2009). Moreover, measuring or otherwise verifying the soil carbon on thousands of farms and aggregating that information will cost considerable amounts. Carbon market proponents admit that "*much of the carbon finance generated from these projects will be needed to defray costs of project management and technical support*" (Forest Trends et al, 2010). In REDD projects "*the process of counting carbon was a dominant cost factor in project development*" (The Munden Project, 2011). This is likely to be the case with agricultural soil carbon.
- *Revenues principally go to intermediaries.* Aggregators of many smallholders will have a central role in creating projects and they will earn most of the money generated by the credits. Intermediaries are likely to obtain monopsony positions, where a few buyers are able to dictate terms to the many smallholder sellers. This will enable them to buy credits cheap and undermine the development objectives of the schemes.
- *Soil carbon will be highly discounted to address permanence, uncertainties, and other issues that might trouble investors.* Even with discounting, there is no indication that investors will actually buy the credits.

In reality, the system is biased against smallholders and may further marginalise smallholders while supporting large landowners and wealthier farmers:

- Because of the huge transaction costs, project developers are likely to favour working with large landowners rather than smaller landowners as this would minimise the number of parcels to be aggregated.
- Better land will generally sequester more carbon because soil fertility increases the production of organic material that can be incorporated into the soil (De Pinto et al, 2010; McKenzie, 2011). As wealthier farmers are likely to be on better quality land, they will disproportionately benefit from a market in soil carbon.
- Many measures require the addition of more organic materials, such as composts and manures. In many smallholder production systems this will not be possible to the optimum extent as crop residues may be needed for feeding animals or dung for use as fuel (Lal, 2009; Smith and Oelsen, 2010).
- In general, "*best management practices that generate the highest sequestration rates are economically not feasible for the majority of local smallholders, unless considerable financial support is provided*" (Tschakert, 2004).
- Soil carbon sequestration requires long-term commitment and often binds farmers to certain types of agricultural practices and land management practices. This may negatively affect the adaptive capacity of poor farmers, who may need to change their production systems to adapt to new climate conditions and economic needs. "*Due to the very 'local, complex, diverse, dynamic and unpredictable' realities of poor people's lives, farmers are more concerned with adapting to their constantly changing environment… Decisions regarding land use and management are characterized by high spatial and temporal variability and determined by a variety of factors. … Hence favoring a prescribed package of 'best' management practices that score highest on sequestration rates … might in fact undermine farmers' dynamic and diverse adaptation mechanisms and, thus, increase rather than reduce their vulnerability to risk*" (Tschakert, 2004).
- If soil carbon prices rise as the overall price of carbon credits rises, land will become more valuable for its carbon sequestration potential. This will create yet another reason for dispossession

of land of the poor and powerless.

- Farmers holding secure and private title to land are the ones most likely to be included in projects. If the land title is not secure, then the ownership of the carbon sequestered on that land could be in doubt. This would make purchase of carbon credits an even riskier investment than it already is. Women farmers often are not the holders to the title of the property they farm and will be disproportionately disadvantaged because of this.

The question of tenure and title. Creation of a soil carbon market, and in particular efforts to encourage reluctant investors with proof of ownership of the credits being sold, is likely to intensify pressures to favour formal or statutory legal title over customary tenure systems. When the state dissolves the beneficial ambiguity that currently exists between formal and customary tenure systems by favouring formal title, those individuals who have access and use rights under customary systems will lose them (Tschakert, 2004; Unruh 2008). "*Land rights are particularly insecure for groups with little political weight at local or national levels, such as women, pastoral herders and migrants*" (Toulmin, 2011).

Despite the above concerns around how much money from soil carbon markets is likely to reach the smallholder, agricultural economists in institutions such as IFPRI use unrealistic assumptions[2] to draw conclusions such as: "*linking smallholder farmers to voluntary carbon markets—though fraught with difficulties—can have a large monetary payoff (estimated at up to US$4.8 billion per year for [sub-Saharan Africa] as a whole) if implemented successfully*" (Bryan et al, 2010).

Box 2: The Kenya Agricultural Carbon Project

The Kenya Agricultural Carbon Project is the first agricultural soil carbon sequestration project to be funded through the BioCarbon Fund of the World Bank. Investors in the BioCarbon Fund include governments as well as firms looking to invest in carbon credits. The latter include Natsource BioCF II Investments Corporation, an asset management firm focusing on the carbon market.

Under the project, farmers will receive technical assistance in the adoption of sustainable agricultural land management practices (SALM), such as the use of cover crops, crop rotation, mulching, improved fallows, compost management, green manure, agroforestry, organic fertiliser, and residue management (World Bank Carbon Finance Unit, no date).

The project developer and implementer is the Swedish NGO Swedish Cooperative Centre – Vi Agroforestry Programme. This is described as "a development cooperation organization that works with support to farmers in the Lake Victoria Basin in Eastern Africa." (SCC-Vi Agroforestry, http://www.sccportal.org/Vi-Agroforestry-Programme.aspx.) Vi Agroforestry will serve as technical advisors for the adoption of SALM practices and, with regard to creation of carbon credits, they will carry out baseline data gathering and will likely do all the monitoring. They will serve as aggregator of the 15,000 farmers in the project (to be increased to 60,000 over the life of the project) and will also be the intermediary

2. The authors base their calculations on an estimate of 265 million metric tonnes of sequestration resulting annually from implementing changes in cropland management, grazing land management, restoration of organic soils, restoration of degraded land, and other practices on over a billion hectares across the continent. This is based on theoretical calculations of sequestration potential by Smith et al(2008). Simple mathematics shows the IFPRI economists are using a carbon price of $18 per tonne. They are also assuming that the voluntary markets would spend US$4.8 billion annually on soil carbon credits in sub-Saharan Africa alone. Yet, as noted above, the value of the entire voluntary market was US$387 million in 2009.

selling the carbon credits to the BioCarbon Fund. The BioCarbon Fund is funding the process to develop a verifiable measurement methodology, as well as funding Vi's technical support and the costs of monitoring.

Information is scarce on the project. From the limited news coverage and information found on the World Bank's website (World Bank Carbon Finance Unit, no date), the following basic facts can be pulled together:

- The project will last for 20 years.
- Initially 15,000 farmers on 7,000 hectares will be involved. This number is projected to grow to 60,000 farmers on 45,000 hectares.
- The project documents estimate that 1.37 tonnes will be sequestered per hectare per year. This estimate appears to be based on a misinterpretation of the IPCC AFOLU guidelines. The project developers have mistakenly used a unit-less stock-change factor as an estimate of carbon sequestration. Use of the AFOLU Tier 1 methodology would provide an estimate of somewhere between 0.15 and 0.72 tonnes sequestered per hectare per year depending on soil type and practices implemented.
- The amount of sequestered carbon will be discounted by 60% to address issues of uncertainty and permanence. Using their estimates for hectares in the project over a span of 20 years and a sequestration rate of 1.37 tonnes per hectare per year, after discounting there will be an estimated 618,000 tonnes of carbon credits to sell (Wekesa 2010). Using a more reasonable sequestration rate of 0.5 tonnes per hectare per year and discounting for non-permanence yields 225,000 tonnes.
- At least 60% of the annual payments received by Vi Agroforestry will be directly transferred to participating farmer groups. The other 40% will go to Vi Agroforestry for project implementation and advisory services.
- The Bank is, at least initially, paying US$4 per tonne of carbon sequestered, for 150,000 tonnes. They have an option to purchase the remaining 468,000 tonnes at an undetermined price. If those remaining credits are not purchased by the Bank, they would be sold on the open market at market prices.
- Estimates of the total cost of the project over the 20-year life span range from US$1,871,145 to US$2,483,159. Project implementation costs are estimated at 52% of the total costs, or US$1,293,600. Total revenue is calculated as 618,000 tonnes at US$4 per tonne, or US$2.48 million. Total payments to farmers over the 20-year time span are estimated at US$316,819. All these figures are calculated by the authors assuming a sequestration rate of 1.4 tonnes per hectare per year (Woelcke and Tennigkeit, 2010). A sequestration rate of 0.5 tonnes per hectare, yielding 225,000 tonnes available to market over the life of the project, would generate only US$900,000 at a carbon price of US$4 per tonne, less than half of the total cost of the project.
- Based on the information available, and assuming a more conservative sequestration rate of 0.5 tonnes per hectare, we calculate that a smallholder farmer owning an average-sized 0.6 hectare plot can expect to receive about US$0.29/year for her soil carbon, or less than US$6.00 over the life of the project. A sequestration rate of 1.4 tonnes per hectare would net the farmer about US$0.81 per year.
- According to Vi Agroforestry: "Co-funding with Swedish aid authority to fill the gap between carbon price and required revenue, the carbon revenue just covers investment costs. The benefits to the farmers come through co-benefits, e.g., increase in yields and support system set up for the project" (Wekesa 2010).

The Bank's Project Information Document states clearly that co-benefits are more important than the amount of money that farmers will receive:

"Co-benefits are key drivers for adoption and maintenance of carbon sequestering activities: With regard to agricultural carbon projects, financial benefits from carbon revenues can be expected to be only a small proportion of the benefits of increased crop yields. Therefore, the primary focus of this project type should be on increasing agricultural productivity and the carbon revenues can be considered as an additional incentive and catalyst for the adoption and maintenance of improved agricultural practices and technologies. ***The level of potential carbon revenues should be clearly communicated at the farm level to avoid false expectations"*** (World Bank Project Information Document 2010) [emphasis added].

iv. Investing resources in establishing a soil carbon market diverts attention from the central question of how to generate public finance that can be used in part to address food security threats posed by climate change

The World Bank and other soil market proponents argue that regardless of how much money goes to individual farmers through carbon trading, there are huge sums of money that could be mobilised for agricultural extension and development through the carbon market. However, the creation of a soil carbon market should not be the driver of the adaptation agenda. Indeed, increasing levels of soil carbon must be seen merely as a co-benefit of policies and practices designed to increase the food security and resilience of agricultural production systems in the face of climate change. Food security and systems resilience must be the guiding objectives of adaptation efforts.

In addition to the significant resources being invested in setting up a market for soil carbon, the World Bank is also investing money at the country level to develop the policy and institutional framework to enable soil carbon trading. In Kenya, the World Bank is supporting the design and implementation of a readiness process, including:

- "support for the development of an institutional framework facilitating climate-smart[3] agricultural development;
- development of Monitoring, Reporting and Verification (MRV) guidelines for the agricultural sector at national level;
- identification (and possibly testing) of financial instruments which have the potential to leading (sic) to scaling-up of these investments" (Magambo, 2011).

With the Kenya Agricultural Carbon Project and the readiness process described above, Kenya is serving as a pilot country for the World Bank. The Bank's Comprehensive Africa Agriculture Development Programme aims to begin similar institutional and policy development across Africa, establishing the conditions for a continent-wide soil carbon market.

The creation of a soil carbon market results in significant misallocation of resources for adaptation and agricultural development. Policymakers are distracted by the efforts to create market-friendly institutions.

3. The FAO defines "climate-smart agriculture" as "agriculture that sustainably increases productivity, resilience (adaptation), reduces/removes [greenhouse gases] (mitigation), and enhances achievement of national food security and development goals" (FAO, 2010).

Effective participation in the market means that smallholders, researchers and development professionals must worry about measuring and maintaining the amount of carbon in the soil, rather than prioritising the many steps necessary to adapt effectively to a changing climate and enhance food security.

The opportunity cost of a researcher determining soil carbon sequestration rates is one distracted from the task of improving soil health and productivity. The opportunity cost of a policymaker designing policies to facilitate a soil carbon market is the distraction away from improving local marketing possibilities and alternative livelihood strategies for small farmers. Siphoning the substantial financial and human resources that are currently being directed towards creation of a carbon market away from the massive adaptation challenges ahead will have long-lasting and costly impacts on future food security.

Instead, policymakers, development professionals, farmers and ideally the world's bankers should work from a broad and holistic view of the adaptation challenges. Food security rather than carbon sequestration should be the desired end. This effort will entail developing national and regional adaptation plans that focus on the most significant needs and directing appropriate resources to those ends. The sequestration of soil carbon must be considered as a tiny piece of an agenda centred on ensuring food security in the face of a changing climate. This point is summarised succinctly by the Terrestrial Carbon Group (McKenzie, 2011): "*At the national level, soil carbon should be couched within a broader policy framework of sustainable land management, agricultural productivity and food security. … A more diversified response is needed at the international level, beyond carbon markets. … In other words, carbon is the co-benefit, not the other way around.*"

v. Smallholder farmers should not be asked to bear the mitigation burden of developed countries and their citizens

Soil carbon sequestration ***does not reduce*** *global emissions. Instead, it merely relocates emissions until the gases sooner or later return to the atmosphere. Soil carbon compliance offsets meanwhile aid developed countries to postpone their own emission reductions. Unless there are real emission reductions by developed countries, smallholder agriculture will suffer profoundly, and we will be no closer to averting a global climate catastrophe.*

Perhaps the most profound impact of a potential soil carbon compliance offset market on smallholder farmers is the fact that continued reliance by developed countries on an offset market means real emission reductions do not happen, particularly in the developed countries. Instead, emissions may be moved into trees and soils, but the structural changes needed at the economic level to move towards low - or zero-carbon economies are postponed. **Developed countries continue to emit greenhouse gases and agriculture remains significantly at risk.**

The creation of the soil carbon market also shifts attention from the real climate culprits. Developed countries are historically responsible for the vast majority of greenhouse gases currently in the atmosphere. Poor and vulnerable countries, including island nations and most of sub-Saharan Africa and South Asia, have contributed least to the climate crisis and are being hit first and worst by climate impacts. Yet instead of reducing emissions at home, developed countries are designing elaborate offsetting schemes that avoid reducing their own emissions and reframe the conversation around the marvellous mitigation potential that exists in developing country agriculture. Such schemes are a way of displacing the work and challenges of reducing carbon emissions away from those responsible for most of past, present and future emissions, and onto those least able to control the terms of their participation. This echoes economic and social patterns that have marginalised Africa and other regions for decades, indeed centuries.

Most disturbingly, "*the 'sustainability' of finance from carbon trading is … structurally reliant on the failure to reduce emissions adequately in industrialized countries*" (FERN et al, 2011).

vi. A soil carbon market is a distraction used by developed countries to evade their obligations to deliver on climate finance

The climate challenge is immense. Estimates of the cost of adaptation alone in the coming decades are up to US$100 billion a year. These costs must be borne by those most responsible for the climate problem. However developed countries are looking to the private sector, to the carbon marketplace, to help them avoid the difficult question of where to find the money. It seems that this question is easily answered when wars must be funded or banks bailed out, but not when the fate of humanity is at risk.

Among their legal obligations under the UN Framework Convention on Climate Change (UNFCCC), Article 4.4 "*commits developed countries to assist developing countries that are particularly vulnerable to the adverse effects of climate change in meeting the costs of adaptation to those adverse effects*" (South Centre, 2011). Disappointingly, negotiations under the UNFCCC over the last several years have demonstrated just how reluctant developed countries are to assume financial responsibility for the consequences of their historical and current greenhouse gas emissions which now threaten lives and livelihoods.

In negotiations on the Copenhagen Accord and subsequent Cancun Outcome, developed countries have sought to minimise the contribution of public funding to global mitigation and adaptation efforts. Instead, they have shifted much of the burden off their shoulders and into the private markets. In the Cancun Outcome, developed countries agreed to "mobilise" US$100 billion per year, by 2020, for both adaptation and mitigation needs, with monies coming from both public and private sources. Yet global adaptation needs alone are predicted by the FAO to be US$30-100 billion per year between 2010 and 2050, with mitigation funding requirements adding a further US$139-175 billion (FAO, 2010).

There are various innovative mechanisms that could be used to generate substantial public finance for adaptation and mitigation. A tiny tax on financial transactions, use of IMF Special Drawing Rights, and levies in the shipping and aviation sector, are all viable options. To date, however, countries have not been able to agree on a single mechanism to generate public finance.

Instead, the possibilities of private finance are used to fill the gap between need and will. Large hypothetical sums are posited (recall the IFPRI figure of US$4.8 billion per year that could come from the voluntary carbon market in sub-Saharan Africa) to assuage concerns and absolve developed country governments of financial responsibility for adaptation to the impacts of their historical and current emissions.

Conclusions and Recommendations:
What is really needed?

There are serious challenges ahead for continued food production under the conditions of changing climates across the world, and in particular for the smallholder sector in developing countries. Ensuring continued food security in a changing climate will require attention to the full range of production and institutional adaptations necessary to increase the resilience of food and livelihood systems. Why invest so many resources into MRV and creation of new institutions that deliver US$0.29 per year to smallholders that follow their rules? These are significant opportunity costs borne on the backs of smallholder farmers who need a more expansive vision from policymakers and global financial institutions.

Substantial, stable, predictable, new and additional public finance is essential to fund adaptation and food security efforts. Resources should be directed towards agroecological approaches that increase soil health and crop productivity, while at the same time increasing the water-holding capacity of soils and the overall diversity of cropping systems. Investment is needed in traditional water-harvesting and retention technologies, such as the Zaï pits used in the Sahel, and their diffusion. Farmer-led crop variety development and seed production systems that link farmers with researchers to rapidly develop and disseminate new varieties need support. Both agroforestry and urban agriculture systems can play key roles in future food security under climate change and must be developed and supported. The bottom line for directing climate finance is that **adaptation and food security must be the central objectives of agricultural policies in a warming world.**

A number of viable and innovative new mechanisms have been proposed as sources of stable, public climate finance to help countries confront climate change. Special drawing rights, a financial transaction tax, redirection of fossil fuel subsidies, a tax on international aviation tickets, and a tax on fuel used for shipping goods internationally together could generate more than US$100 billion in public finance annually. Political will is, of course, needed to overcome the domestic hurdles faced by these proposals in many developed countries. Equity issues must also be dealt with for those mechanisms, such as a fuel tax, that might unfairly burden developing countries.

Finally, developed countries must immediately and rapidly reduce their emissions of greenhouse gases domestically. Only immediate and real reductions in emissions can prevent further humanitarian catastrophes such as the current drought and famine situation in the Horn of Africa. Every year that emissions continue at their current rate puts the lives and livelihoods of millions of the world's poor are increasingly at risk. Developed countries not only have the historical responsibility to address the impacts of their emissions on the world's poor, they also have the means to do so. One of the first steps that must be taken, in December in Durban, is to agree on an ambitious, legally binding second commitment period for the Kyoto Protocol.

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