Photo: Kennemer

Promoting the role of smallholder farmers in the mitigation of **climate change**[1]

Introduction

Agriculture, forestry and climate change are highly intertwined. Agriculture contributes towards climate change through the release of greenhouse gas (GHG) emissions. Between 2010 and 2019, researchers suggest that agriculture contributed 13-21% of total global GHG emissions.[2] The conversion of non-agricultural land, such as forests, into agricultural land, is also a significant contributor to climate change.

Due to effects on yields caused by changing weather conditions, and higher vulnerability to shocks caused by extreme weather events, the agriculture sector is also highly influenced by the consequences of climate change. For example, a global survey among FairTrade certified coffee farmers found that the majority (76% of farmers) had experienced productivity declines due to climate change and that they were unable to access adaptation and mitigation measures (Fonseca, 2013). Smallholder farmers are also prone to high levels of vulnerability due to numerous other risks attached to agricultural production, such as pests and diseases and market shocks (O'Brien et al., 2004). Such vulnerability is bound to undermine progress towards global poverty alleviation, food security, and sustainable development.

This article explores the drivers for smallholder farmers' participation in climate change mitigation. In particular it aims to describe the mechanisms by which smallholder farmers can participate in and benefit from programmes which offset or inset carbon emissions and offer incentives for the provision of ecosystem services.

Attention is already being paid to **adaptation strategies** to support smallholders in dealing with the risks and shocks posed by climate change, such as climate-smart practices, regenerative agriculture, and agroforestry systems (Akinyi et al., 2021). Less attention, however, has been given to the opportunities for smallholders to become involved in and benefit from **mitigation strategies**, i.e., those that aim to reduce and remove GHG emissions.

The latest report of the Intergovernmental Panel on Climate Change (IPCC) states that the agriculture and forestry sector *"offers significant mitigation opportunities while delivering food, wood and other renewable resources as well as biodiversity conservation"*.[3] According to the IPCC, the sector as a whole has the potential to provide 20-30% of the global mitigation

[1] Authors: Stefan Petrutiu, Maria Vitores, Verena Bitzer and Froukje Kruijssen, KIT Royal Tropical Institute, Amsterdam, 2022
[2] https://report.ipcc.ch/ar6wg3/pdf/IPCC_AR6_WGIII_FinalDraft_TechnicalSummary.pdf; accessed on 13/06/2022
[3] Idem; TS-84, accessed on 13/06/2022

needed for a 1.5 or 2°C pathway towards 2050.[4] Small-scale farms (of less than 2 hectares) account for 84% of all farms worldwide (i.e. more than 510 million farms are considered 'small'), cover around 12% of agricultural land, and produce roughly 35% of the world's food (Lowder et al., 2021), and therefore this sector also needs to play a more important role in this exercise of mitigation.

In order to develop mitigation strategies for smallholders, more attention is required to create new financial mechanisms and incentives that recognise and promote behavioural changes towards more sustainable practices (Amrein et al., 2015). Examples of such mechanisms include payment for ecosystem services (PES), and carbon offsetting and insetting. Carbon offsetting and insetting are measures taken by companies that lead to a reduction or removal of emissions of carbon (or other GHGs), outside or within their supply chains respectively, to compensate for their emissions.

This article undertakes a literature review and then outlines three case studies to look at opportunities and challenges of carbon markets, and the conditions under which they could work for smallholder farmers.

Carbon markets and agricultural value chains

A carbon market sets a cap on allowable GHG emissions, with that cap incrementally declining as the years go on to meet emission reduction goals. A government issues emission credits that add up to the cap on emissions. Companies and organisations that are required to comply with the emissions cap, can then buy and sell emissions i.e., carbon offsetting credits, which creates a financial incentive for them to pollute less. Carbon offsetting has been in existence for some decades but was particularly spurred on by a number of key events such as the 1995 Kyoto Protocol, the 2005 EU Emissions Trading Scheme, and the 2015 Paris Agreement.[5]

Two types of markets exist for carbon offsetting; compliance and voluntary. The first is governed through mandatory and legally-binding caps on carbon emissions, and the latter is built around voluntary actions of companies, organisations or governments to mitigate their GHG emissions and meet emission reduction goals. The voluntary carbon market has been developed around international and country-level GHG targets, set as part of the UN Climate Change Convention, with the majority of credits bought by organisations to offset emissions which are 'produced' through projects that involve farmers around the globe taking part in reforestation projects, or projects which offer them clean cooking stoves, for example.[6]

In most countries, the food and agriculture sector does not yet fall under a mandatory emission trading system. At present, New Zealand is the sole example of a country in which agricultural emissions must be monitored and reported under its Emissions Trading Scheme (NZ ETS). Companies in the sector have been disclosing their carbon footprints and other environmental data, for example, through the Carbon Disclosure Project,[7] but setting targets and taking coordinated action on climate change in the sector has been a slower process. Currently, the focus is still on avoidance and reduction, with just a few companies aiming for net zero status by offsetting their remaining emissions through the purchase of carbon credits.[8]

The concept of insetting emissions is much newer, with a first conference dedicated to the topic organised in 2014 by Plan Vivo.[9] Insetting is a more direct way for farmers to generate carbon credits (e.g., through reforestation or agroforestry), as companies sourcing from them can purchase their credits while reducing carbon footprints in their supply chains (Amrei et al., 2015).

The voluntary carbon market is primarily driven by supply and demand and therefore prices for carbon credits vary widely.[10] The price variation is also due to different valuation approaches. For example, the Fairtrade and Gold Standards set a minimum price using a cost-based approach for credits derived from forest management projects of EUR 13 per tonne CO_2e,[11] plus EUR 1 as a Fairtrade premium.[12] Others take a so-called 'value-delivered' approach, in which carbon credits can account for

[4] https://report.ipcc.ch/ar6wg3/pdf/IPCC_AR6_WGIII_FinalDraft_Chapter07.pdf; accessed on 13/06/2022
[5] https://impactful.ninja/the-history-of-carbon-offsetting/#:~:text=Carbon%20offsetting%20began%20in%201989,and%20the%202015%20Paris%20Agreement; accessed on 20/05/2022
[6] GHG targets must be met through national adaptation and mitigation measures and various market-based mechanisms, such as the Clean Development Mechanism (CDM). The CDM allows the setting up of projects in developing countries which can earn certified emission reduction (CER) credits, each equivalent to one tonne of carbon. Third parties must validate, verify and register carbon data, "a rigorous and heavy procedure aimed to ensure that real, measurable and verifiable emission reductions are realised which are additional to what would have occurred without the implementation of the climate project or the 'baseline' situation". There is a growing interest in the development of economic instruments which fit under the CDM or under voluntary standards, and which use adaptation and mitigation measures and ecosystem services for climate change mitigation.
[6] https://www.cdp.net/en/companies/companies-scores; accessed on 20/05/2022
[8] https://sciencebasedtargets.org/net-zero; accessed on 20/05/2022
[9] For a full timeline of progress on insetting, see page 7 of the Insetting Guide: https://www.insettingplatform.com/wp-content/uploads/2022/03/IPI-Insetting-Guide.pdf; accessed on 20/05/2022
[10] https://www.goldstandard.org/blog-item/carbon-pricing-what-carbon-credit-worth; accessed on 21/05/2022
[11] CO_2e (CO_2 equivalent) is the number of metric tonnes of CO_2 emissions with the same global warning potential as one metric tonne of another GHG
[12] See footnote 9; accessed on 21/05/2022

Photo: Adobe stock

Box 1 | 4C Climate Neutral Coffee

The coffee giant JDE Peet's is a good example of increased commitment and effort to reduce emissions, while including farmers in its supply chain in relevant projects. The company committed to reduce absolute Scope 1 and 2 GHG emissions by 25% and absolute value chain Scope 3 GHG emissions by 12.5%, by 2030 from a 2020 base year. It recognises that its GHG emissions are primarily indirect (Scope 3), and that its Scope 1 and 2 emissions make up less than 10% of total emissions along the entire value chain. As coffee cultivation accounts for approximately 90% of the carbon footprint of roasted coffee, JDE Peet's engages in projects with smallholder farmers and partners (e.g., in Tanzania with Touton and Karagwe District Cooperative Union) to increase yields while reducing emissions at farm level. The company's project in Tanzania pilots the new voluntary 4C Carbon Footprint Add-On of the 4C Code of Conduct certification for coffee (launched in 2022). This certification offers companies and their supply chain partners a tailored solution to understand the current impact of their operations on the climate and proposes solutions on how to reduce and mitigate GHG emissions, as well as on how to communicate these efforts with their consumers. The last level (4) of the certification includes carbon compensation to differentiate the companies that offset emissions which cannot be eliminated, by paying for carbon credits created through 'qualified carbon projects'. Certified companies who complete Level 4 can sell the coffee as 4C Climate Neutral Coffee.

Sources: https://www.jdepeets.com/sustainability/minimised-footprint/climate-action/; https://www.4c-services.org/working-towards-climate-friendly-coffee-production-in-tanzania/; https://www.4c-services.org/process/add-ons/carbon-footprint/.

full environmental, social and economic impacts of specific projects, and may be priced above EUR 177 per tonne CO_2e (e.g., Swiss retailer Coop pays roughly USD 150 per tonne).[13]

According to the leading GHG Protocol's Corporate Standard, GHG emissions are classified into three scopes. Scope 1 (direct activities of the company) and 2 (indirect activities of the company upstream in the chain) are mandatory to report, whereas Scope 3 (indirect activities downstream in the chain) is voluntary.[14] As a result, many companies only report on Scope 1 and 2 emissions, from owned or controlled sources of the organisation, and not for Scope 3 emissions. However, a rapidly increasing number of companies are committing to compensate for their indirect emissions too (see Box 1 for an example).

Smallholders' participation in climate change mitigation through carbon markets

For smallholder agriculture, three types of mitigation measures can be distinguished: i) emission reductions by reducing rates of land-use change, reducing deforestation, or improving the efficiency of production systems, such as through practices that deliver added nitrogen more efficiently to crops; ii) GHG removal enhancement, such as carbon sequestration in the soil or in belowground or aboveground biomass; and iii) reductions in dependence on firewood as a primary fuel, for example by introducing alternative fuel cooking stoves (Cohn et al., 2017).

Promoting these measures among smallholders in practice is associated with a range of challenges. For example, the large

[13] See footnote 9; accessed on 21/05/2022
[14] https://plana.earth/academy/what-are-scope-1-2-3-emissions/; accessed on 21/05/2022.

numbers of scattered smallholders mean there are high implementation and transaction costs. Furthermore, smallholders that participate in such efforts face direct trade-offs in their time and costs of labour, and use of available resources (Akinyi et al., 2021). The voluntary nature of carbon offsetting in the agricultural sector inhibits both the efforts at financing adaptation and mitigation, and creating incentives for smallholder farmers to increase their participation. Furthermore, certification processes are costly, resulting in difficulties in partnering with farmers.[15] Activities such as carbon measurement, monitoring, verification, certification and traceability, are complex and expensive, and demand experienced partners. For example, Rabobank's Acorn scheme (Box 2) needed a large group of partners to come into existence.

There is also a lack of institutional support, uncertainty over long-term additionality and trade-offs, weak governance, fragmented land ownership, and uncertain permanence effects that affects participation in mitigation measures in agriculture.[16] Smallholders' participation in land-based carbon payment projects is negatively affected by insecure land tenure and limited resource capacities among marginalised smallholders (Tamba et al., 2021). Finally, the majority of carbon credits are generated by forestry (REDD+) and large-scale renewable energy projects, which according to the Fair Climate Fund have been shown to have very little to no additionality (i e., reductions would have been realised without carbon finance and therefore the offset claim is not legitimate).[17] The large supply of such credits also results in a very low price in the voluntary carbon market, which does not reward smallholder farmers sufficiently for their extra labour.

To facilitate smallholder (and community) participation, carbon standards such as Verified Carbon Standard, Verra, Gold Standard, Plan Vivo and the Fairtrade Climate Standard, which emerged to verify that carbon offsetting projects positively impact the environment, provide guidelines on participation of local communities throughout the different phases of an emission reduction project (Tamba et. al., 2021). Yet, the guidance of how to do so is not harmonized across standards and smallholder farmers often do not know how to join the voluntary carbon credit markets to receive financial benefits for the emissions they remove (Tamba et. al., 2021).

Still, thousands of projects have already included small producers through focus groups discussions, interviews or participatory workshops at community levels (Tamba et al., 2021). Evidence shows that the main incentives for the participation of smallholder farmers in land-based carbon payment schemes are non-monetary. These include improved yields, access to financial advisory services and credit, local infrastructure investments and the development of income-generating activities (Tamba et al., 2021). But, financial incentives, i.e., cash payments to farmers for mitigation through carbon markets, also drive more smallholder participation in mitigation strategies (e.g., adoption of climate smart practices after relevant trainings).

The carbon market is highly dependent on worldwide regulatory efforts to hold countries accountable for their climate impacts and is described by some experts as the 'wild west', with rules that differ between countries, and with emissions often unregulated by a recognised body.[18] The cases presented below highlight the need for more regulatory and mandatory GHG reduction targets to benefit farmers. The cases also reveal that farmers are not experiencing sufficient demand for carbon credits.

Box 2 | The Acorn platform for carbon credits for offsetting emissions

One new player on the carbon market (for offsetting) is Rabobank, which developed the Acorn platform to include smallholder farmers in agroforestry practices using modern technologies. Its objective is to build a global, transparent carbon removal system for smallholder farmers, using carbon removal units (CRUs) based on actual carbon stored in planted trees. These CRUs are sold after trees convert carbon into biomass, measured through remote sensing technology, such as satellite imagery. The platform also combines the use of artificial intelligence (AI) and machine learning for vegetation monitoring, and biomass and carbon stock estimations. Rabobank points towards the platform being unique, as the CRU differs from typical carbon credits, by representing actual carbon no longer in the atmosphere. It currently hosts ten projects with 5,000 farmers and has three corporate voluntary clients.

Source: https://acorn.rabobank.com/

[15] https://intelligence.coffee/coffee-farmers-carbon-credit-schemes/; accessed on 14/05/2022
[16] https://report.ipcc.ch/ar6wg3/pdf/IPCC_AR6_WGIII_FinalDraft_Chapter07.pdf; accessed on 13/06/2022
[17] https://www.fairclimatefund.nl/content/4-meer-weten/2-kennisbank/position-paper-fairclimatefund-nov2021.pdf; accessed on 21/05/2022.
[18] https://www.bloomberg.com/professional/blog/carbon-offsets-price-may-rise-3000-by-2029-under-tighter-rules/; accessed on 20/05/2022

Empirical cases

Empirical case 1: Colcocoa (PlanT)[19]

Colcocoa, an innovative business which the Common Fund for Commodities (CFC) has been engaging with, is a specialised cocoa trading company, operating in Colombia since 2012, which is working with cocoa producers and value chain actors to produce and supply high quality cocoa. Colcocoa's vision is to improve the wellbeing of producers, and promote economic opportunities for cocoa-producing communities, while preserving the environment and promoting sustainable agriculture. One of the priorities of Colcocoa is to provide alternative sources of income for cocoa producers engaged in sustainable practices. Its carbon offsetting programme fits into this goal.

To promote environmental conservation, Colcocoa set up a reforestation programme. The programme is implemented in coordination with Echar Pa'lante and PlanT, two organisations created by Colcocoa. Echar Pa'lante is a verified sustainability programme for all of the producers associated with Colcocoa. After identifying producers to take part, Echar Pa'lante engages and coaches them through the carbon offsetting programme, provides agriculture advisory services to members on sustainable forestry and agriculture practices, and verifies the compliance of producers with its code of conduct which lays out the compliance requisites for the certification. The certification process was put in place in collaboration with Ceres, which certifies the cocoa as sustainable cocoa.

The carbon offsetting model

The carbon offsetting model of Colcocoa operates in the voluntary market and is enabled by PlanT, a marketplace tool that offers the possibility for companies and individuals to purchase carbon credits and financially support the reforestation program. PlanT is built using blockchain technology which offers a fully transparent and traceable mechanism based on a smart contract. An additional feature of PlanT is the direct relationship with the farms. Each tree planted can be georeferenced which enables any contributing party to follow up on the development of the tree. The approach to validate, verify and register carbon data is direct measurement, requiring experts to go into the field to take measurements and validate these, which is based on the methodology developed by Ceres and adapted for cocoa producers. To secure sales of carbon credits, Colcocoa currently relies on its partners to disseminate the programme (Green Furniture Concept, Rotary Club in Bourg and Bresse and Domaine de la Garde).

Photo: Colcocoa

Farmers participation

Where initially there was no direct link between the cocoa producers and the reforestation activities, the carbon offsetting model has now moved to a new phase in which there is a direct link between reforestation and carbon offsetting activities and the cocoa producers. In the short term, income is generated through soil preservation and water management activities led by Echar Pa'lante, that should lead to improved productivity. The programme has now expanded to include reforestation and the preservation of existing trees.

The model is being piloted with 14 producers engaged on a voluntary basis through a participatory process led by Echar Pa'lante. During this engagement phase, the interaction with producers focuses on the benefits of sustainable agroforestry practices and technical assistance to guide producers on the best options. The expected benefit for the producers is cash payments in return for their participation. Another incentive for producers is the long term potential for additional income from selling sustainably managed wood.

Valuation and payments for carbon credits

PlanT operates on the basis of carbon capture estimates that were developed with technical assistance from the University of Bern in Switzerland, and the University of Caldas in Colombia. These vary depending on the conditions surrounding the tree and the species planted. For example, for the original tree planting programme, each tree will capture 0.3 MT of carbon during its cycle of 12 to 20 years. In the new pilot programme, which expanded to include existing trees in the cocoa producers' farms, the estimates range between 2.9 and 22.5 MT per tree. This wide range is explained by factors such as soil, tree variety, local agro-ecological conditions and the plantation age.

[19] Alvarez, G. (2022). Personal communication. Interview conducted on 19/05/2022

Photo: Colcocoa

Colcocoa expects to sell the carbon credit at USD 12/MT for payment for environmental services and USD 15/MT in case of forest conservation. Another possibility is to contribute to the planting of trees. Colcocoa receives USD 3.5 for each tree planted and from this the producer receives 60% in cash. Farmers sign a contract with Colcocoa where targets and each party's obligations are specified. This is registered in the Registro Nacional de Reduccion de Emisiones to avoid double counting. The contract is valid for up to 3 years and for a maximum of USD 3,600 per farmer. Colcocoa guarantees the payments for the first-year, equivalent to USD 1,100.

A large incentive for farmers to be part of the programme is the premium price that Colcocoa pays for 1 MT of carbon (USD 7) compared to the national market (USD 3). An additional benefit for the farmers is provided by the advisory services provided by the technical staff of PlanT on what species are suitable and how to maintain the trees. However, so far, the producers have not received any compensation. The first payment is expected in August-September 2022. By then, Colcocoa expects to obtain some funds from the sale of carbon credits through PlanT, but will still make the payments for the first three years itself should the funds generated be insufficient.

Costs and investors

Apart from the technical assistance of the two universities involved, Colcocoa also received support from the Swiss government through the Swiss Platform for Sustainable Cocoa for the current pilot to use for measurement systems, methodology and initial visits. In Colcocoa's model, 40% from the carbon offset sales goes to cover programme operations' costs, the sales platform and verification costs. Additionally, Colcocoa absorbs 50% of programme operation costs as an investment in the pilot phase.

Impact and future

Although Colcocoa offered a price to farmers for carbon credits, above the national market price, it is still exploring avenues for passing on even greater benefits to farmers. Colcocoa intends to scale the carbon offset programme to all of the 3,000 producers that are part of the Echar Pa'lante programme.

The main challenge, however, remains in making the programme sustainable by reducing the operation costs and securing sufficient sales of carbon credits to cover the costs. To reduce costs, the plan is to evaluate alternative methods of measurement and to integrate the management of the carbon offsetting programme into the existing management system and code of conduct of Echar Pa'lante.

Furthermore, Colcocoa hopes to create more efficiency by incorporating aerial technology through satellite imagery to monitor progress and validate estimates, eventually replacing direct in-situ measurements and monitoring practices. The verification process by Ceres is also intended to be simplified so it can be made more affordable.

Empirical case 2: Carble[20]

Carble is a start-up from the Netherlands which uses space technology to reduce the carbon footprint of the coffee supply chain.[21] According to co-founder Sander Reuderink,[22] Carble emerged because of a deep dissatisfaction with the available models of becoming carbon neutral in the sector. Pressure on coffee farmers around the world to earn a living leads to high deforestation rates and the creation of coffee monocultures, which are seen as the most 'efficient' farming system – such as those that can be found in Brazil. When farmers grow coffee in agroforestry systems, for example in Colombia or Ethiopia, they have lower yields and are not rewarded for ecosystem services, e.g., in the form of carbon capture, that they provide.[23]

Many coffee businesses have announced their intention to become carbon neutral by 2030[24] – a situation in which carbon emissions (i.e., which cannot be reduced) are balanced out by carbon removal. Yet, in practice, there are many barriers to achieving carbon neutrality. Acknowledging conflicting assessments of the credibility and transparency of carbon offsets can bring you close to a net zero claim, says Reuderink, but it does not change the situation of coffee farmers who continue to live in poverty and face pressures to switch to more industrial farming systems.

As it is anticipated that global demand for coffee by 2050, which would require tripling current production levels, raising pressure on surrounding forests and other habitats in tropical regions.[25] Farmers will have to look for new land to cultivate. It is, therefore, increasingly necessary to track and measure emissions, and one challenge faced by the coffee sector is the lack of GHG emissions data to calculate, measure, and ultimately demonstrate reductions in carbon footprints.

Carble aims to rectify this market failure by providing the technology for carbon insetting in the coffee chain, i.e., measuring the carbon stored by farmers in agroforestry systems and helping coffee companies to reward farmers for storing even more.

Climate change mitigation approach

Carble is technology-driven approach to insetting carbon. It combines remote sensing with manual field measurements to calculate how much carbon is stored by farmers. Carble uses algorithms based on three types of satellite data – two from the European Space Agency (ESA) (radar-based and optical Sentinel-2 satellites) and one from NASA's Global Ecosystem Dynamics Investigation (GEDI) to measure the thickness of forest canopies. This is combined with manual field measurements, which so far exist only for the Guji region in southern Ethiopia. A Belgian researcher conducted around 60 measurements in this region, determining the biomass and root system in isolated fields of 25 m^2, then the shrubs, dead wood and litter in sub-plots of 5 m^2 and, finally, all living organisms in a single 1 m^2. The calculated carbon storage across the field measurements is fed into the algorithm and extrapolated for an entire landscape. Carble claims that their measurements have an accuracy of nearly 90%.

Carble measures avoided deforestation against a baseline scenario. For example, if the regional deforestation rate is 1% per annum and if farmers store 1,000 MT of CO_2e per hectare, they can claim 10 tonnes of carbon emission reductions per year as ex-post payment. This is the 'delta' compared to the baseline scenario and can be considered for a PES. If farmers also plant additional trees (reforestation), they can increase their delta beyond avoided deforestation, and can be considered for insetting and sales of carbon credits.

The carbon emission reductions achieved by farmers – e.g., 10 tonnes of CO_2e – cannot be sold on the voluntary carbon market, but only to the buyers of their coffee. Buyers can see the carbon storage of their farmers in an online customer portal and include the carbon emission reductions in their Scope 3 carbon accounting.[26] To ensure credibility, Carble follows the international VERRA methodology to report on carbon emission reductions. As such, participating companies can, in future, show the reports from Carble to their auditors and, if they wish, get certified. Carble's business model consists of a subscription-based platform, as well as a commission of 10% on every tonne of CO_2e emission reduction.

Farmers' participation – upcoming pilot project in Ethiopia

Carble is about to embark on a one-year pilot project in the Guji region of Ethiopia with two small Dutch coffee companies: Trabocca (trader) and Beans Coffee (roaster). The project serves to validate that remote sensing works with the accuracy

[20] https://www.carble.co/about-us/; accessed on 31/05/2022
[21] Reuderink, S. (2022). Personal communication. Interview conducted on 19/05/2022
[22] Idem
[23] https://dailycoffeenews.com/2022/03/30/dutch-startup-carble-seeks-to-reward-coffee-farmers-for-maintaining-forests/; accessed on 31/05/2022.https://www.sbicnoordwijk.nl/carble-coffee-industry-storing-carbon/?utm_source=rss&utm_medium=rss&utm_campaign=carble-coffee-industry-storing-carbon; accessed on 25/05/2022
[24] For example, Starbucks committed to Carbon Neutral Green Coffee by 2030 and Nespresso even made the commitment that every cup of Nespresso coffee will be carbon neutral by 2022
[25] https://www.sustaincoffee.org/assets/resources/ci-report-coffee-in-the-21st-century.pdf; accessed on 29/6/2022
[26] Scope 3 emissions are the result of activities from assets not owned or controlled by the reporting organisation, but that the organisation indirectly impacts in its value chain (often called 'value chain emissions'). https://www.epa.gov/climateleadership/scope-3-inventory-guidance#:~:text=Scope%203%20emissions%20are%20the,scope%201%20and%202%20boundary; accessed on 25/05/2022

needed for carbon accounting compliance and that rewarding farmers for their ecosystem services makes a positive impact on their livelihoods.

The pilot will be set up around one larger farm with several outgrowers around it, reaching 100 farmers in total in an area of high potential for carbon storage, high risk of deforestation and low farmer incomes. Interest among farmers to participate was immediately high, even though familiarity with the idea of PES was low. Partnerships between the farmers and with potential roasters who would pay for ecosystem services and carbon credits were already established, as Carble's co-founder used to work at Trabocca. Through this partnership role, Carble's co-founder will work with the farm manager and the outgrowers to deliver extra financial benefits to the farmers. After the completion of the pilot project in Guji, Carble aims to scale the approach to larger groups of farmers and other geographies.

Costs and investors

Carble's start-up funding and support is provided through incubations from the ESA and the German development agency, GIZ. This covers the development and testing of the technology and business model.

The pilot project will test the different value propositions for the participating brands: for Trabocca, it is about understanding the potential for carbon emission reductions and how they can integrate this into their business model. Beans Coffee, by contrast, is already Climate Neutral Certified and will use the carbon emission reductions for their non-financial reporting. As such, it is committed to making the payments to farmers. In the pilot, Beans Coffee will be making the payments to farmers, but in future Carble plans to involve a mobile money operator to send the money directly to farmers. This would also facilitate the automatic capturing of the 10% margin by Carble.

Valuation of carbon credits

Carble aims to monitor the impact of the carbon payments on closing the living income gap of small-scale farmers. This requires an innovative method of valuing carbon emission reductions, by linking the price of carbon to a living income benchmark of a specific region. Currently, Carble's calculations from Ethiopia estimate that farmers have an annual income of around EUR 400 from coffee farming and EUR 120 from other sources, based on a 1.2 hectare farm. If farmers were to be rewarded for carbon storage, they could double their income, but only if the carbon price was set at EUR 30 per MT of CO_2e, instead of the EUR 10 which is standard today. Moreover, even a doubling of farmers' income would not equate a living income. For this to be achieved, a carbon price of EUR 50 per MT of CO_2e would be needed.

Carble co-founder Reuderink believes that the price of carbon emission reductions will rise in the future, as demand for carbon neutral business operations will increase. Carble's concept, however, will only succeed with the participation of sufficient buyers willing to tackle the carbon footprint of their own supply chains.

Impact and discussion

Carble is still in its start-up phase and impact has yet to be traced. Carble's scalability ambition is to generate additional earnings of USD 1 billion for 1 million smallholder coffee farmers by 2030 – a long way to go from the small Ethiopian pilot project, but the company is already attracting attention and a number of coffee brands have made requests for additional projects with 10,000-20,000 farmers.

The company emphasises that upscaling is only possible if the cost for analysing a large number of farmers is minimal based on low-cost, high-resolution technology. At the same time, the reliance on manual field measurements and on high quality data points from participating traders or roasters (e.g., GPS mapping of farms) represent a hurdle that needs to be overcome. This will require an ecosystem of service providers around Carble which can make such services available to coffee brands, according to Reuderink.

One limitation to upscaling is already evident: farms smaller than 1 hectare cannot be included in Carble's model, as there are too few georeferenced points to establish a polygon that outlines the farm and the farm cannot be accurately displayed in satellite imagery.

Photo: Carble

Empirical case 3: Kennemer Eco Solutions (KenEco)

Kennemer Foods International, Inc. is an agribusiness company based in the Philippines that grows, sources and trades cocoa from Mindanao, Visayas and Palawan, as well as banana and abaca fibre. It was established in 2010 as a buying and post-harvest centre, sourcing from smallholder farmers. Realising the challenges these farmers faced in growing quality cocoa, Kennemer started to provide smallholders with inputs and services such as planting materials, training, agri-technology, and linking them to export markets. Kennemer has a contract growing scheme and a programme that trains some farmers as input and service providers, and cocoa bean aggregators. Kennemer also manages its own cocoa farms.[27]

In 2015, Kennemer started Kennemer Eco Solutions Pte Ltd. (KenEco) with the aim of creating a forest restoration and protection programme, compliant with the Verified Carbon Standard (VCS). KenEco is developing a carbon fund as a vehicle to calculate, reduce and offset carbon footprints.[28] The programme is called 'Mindanao Tree Planting Program for Our Climate and Communities' or MINTREES for short.[29] Revenues from the carbon credits are intended to directly benefit farmers in the development of a multi-layered, cocoa-based, agroforestry system, transforming low-biomass areas into carbon-rich productive forests.[30]

Climate change mitigation approach

The idea is that planted trees remove GHG emissions from the atmosphere while shade trees regulate the micro-climate in cocoa parcels, stabilise the ecosystem and improve soil conditions. The project's climate impacts and community co-benefits are certified through VCS and CCBS (Climate, Community, Biodiversity Standard), developed and managed by Verra. Interested companies can purchase tradable GHG credits called Verified Carbon Units (VCUs). Those VCUs can then be sold on the open market and "retired," or used by individuals and companies to offset their own emissions.[31] Where VCS focuses on the reduction of GHG emissions, the CCBS programme adds a wellbeing component that aims to improve livelihoods, create employment, protect traditional cultures and increase the resilience of ecosystems.[32] MINTREES carbon credits have been offered on the aESTI marketplace since April 2022.[33]
The MINTREES project works with a landscape approach.

The project document submitted for the CCBS and VCS request[34] describes that the project involves afforestation, reforestation and revegetation (ARR) activities. It started in 2015 and has continued with annual planting since then. The 2015-2019 planting was subject of the first monitoring period for verification for VCS.

Farmers' participation

The project builds capacity among farmers by training them in multi-crop agroforestry focused on marketable cash crops (e.g., cocoa, banana, abaca), improves access to markets by providing guaranteed offtake with transparent pricing of agricultural produce from agroforestry farms, and establishes agroforestry systems and reforestation areas by delivering seedlings and supervising planting.

The planted area for verification included 2,238 smallholder farms ranging from 0.2 to 6 hectares (average 0.4 hectares), located in Mindanao. The activities were implemented through farmer clusters and cooperatives at village level. The targeted beneficiaries are marginalised smallholder farmers and communities, especially women and minorities. Biannual verification events are planned, when new plantings will be validated and added.

Costs and investors

With funding from the United States Agency for International Development (USAID) Green Invest Asia project, a spatial analysis of deforestation in Mindanao was conducted, to assess past and future deforestation drivers. Using remote sensing (satellite data), a baseline was conducted of carbon stock changes and GHG emissions from unplanned deforestation and wetland degradation for Mindanao. With these data, KenEco can identify potential project areas.[35]

Valuation of carbon credits

The first credits became available on 1 April 2022, and by the time of writing this article, 115 MT of carbon credits has been sold at EUR 30/MT.[36] aESTI facilitates the trade in ecosystem services by connecting supply and demand, and provides KenEco's marketplace for the carbon credits. Their model assures that 90% of the value of each carbon credit goes directly to farmers, with the remaining 10% used to cover the costs of aESTI.[37]

[27] http://www.kennemerfoods.com/about/; accessed on 01/06/2022
[28] https://greeninvestasia.com/usaid-supports-modeling-of-deforestation-in-mindanao-to-launch-carbon-offset-project/; accessed on 01/06/2022
[29] http://www.kennemerfoods.com/2021/10/14/mindanao-tree-planting-program-for-our-climates-and-communities/; accessed on 01/06/2022
[30] https://aesti-impact.com/en/marketplace/66207bf19ac747d192a69f1c96d59803/details; accessed on 02/06/2022
[31] See footnote 27.
[32] https://verra.org/project/ccb-program/; accessed on 03/06/2022
[33] aESTI is the Agricultural eco-system services trading initiative
[34] https://registry.verra.org/mymodule/ProjectDoc/Project_ViewFile.asp?FileID=53170&IDKEY=a98klasmf8jflkasf8098afnasfkj98f0a9sfsakjflsakjf8da73321430; accessed on 03/06/2022
[35] See footnote 27: accessed on 01/06/2022
[36] For comparison, a project which offers carbon credits in the same marketplace indicates a price of EUR 20 per MT see https://aesti-impact.com/en/marketplace/66207bf19ac747d192a69f1c96d59803; accessed on 23/5/2022
[37] https://aesti-impact.com/en/buyers; accessed on 02/06/2022

Impact and discussion

Kennemer, through KenEco, aims to enhance farmer income through the improvement of the crops that are harvested, which should lead to farming communities becoming more resilient to climate change, by reducing soil erosion and increasing the soil's capacity to absorb and retain water, improving water quality and increasing biodiversity. The goal of the project is, by 2064, to remove over 1.2 million tonnes of GHG emissions, establish over 50,000 hectares of forest cover, and to train over 50,000 smallholder farmers (%50 women), and improve their livelihoods and wellbeing.[38]

COVID-19 pandemic travel restrictions delayed administrative processes, data collection and auditor site visits, which impeded the validation of the project within the required 5-year window. Verra granted KenEco two extensions for verification until 31 March 2022.

The first monitoring report, developed in September 2021 by KenEco, reported the following results (see also Figure 1):[39]

- **15,726 MT** of net estimated GHG emission removals in the project area, measured against the without-project scenario.
- **948.43 hectare increase**, measured against the without-project scenario, of:
  - agroforestry systems established with smallholder farmers.
  - forest cover increased in the project area; and
  - area significantly better managed for biodiversity conservation.
- **2,242 community members**, of which 851 women (38%), who, as a result of project activities, have:
  - improved skills and/or knowledge resulting from training;
  - improved livelihoods, or income generated; and
  - improved wellbeing.
- **265 people employed in project activities**, expressed as the number of full-time employees, of which 92 were women (35%).
- **three critically endangered or endangered species benefiting** from reduced threats as a result of project activities, measured against the without-project scenario.

The second validation and verification is planned for 2023, and will include the 2020, 2021, and 2022 planting waves.

Figure 1: Results reported in first monitoring report by KenEco, September 2021[40]

[38] https://registry.verra.org/mymodule/ProjectDoc/Project_ViewFile.asp?FileID=55795&IDKEY=dq934lkmsad39asjdkfj90qlkalsdkngaf98ulkandDfdvDdfhf76941305; accessed on 13/06/2022
[39] Idem: accessed on 13/06/2022
[40] Idem: accessed on 13/06/2022

Photo: Kennemer

Conclusions

Despite the above structural and policy limitations, the first conclusion of this study is that while the majority of literature focuses on increasing the number of smallholder farmers who 'participate' in adaptation and mitigation programmes by introducing new production practices, the evidence gathered for this study shows that, in practice, the first steps to inclusion in carbon markets may largely be dependent on companies, non-governmental organisations and standard bodies.

A second conclusion is that measuring mitigation interventions and carbon stocks, reductions and removals, is often based on methodologies provided by standard setting organisations, which are often unavailable or too complex for farmers. Without easy access, availability and ability to understand and use such methodologies, farmers cannot join and benefit from carbon markets without the support of value chain or enabling partners. Tamba et. al. (2021) also concluded that farmers' participation is negatively affected by their limited resources, and emphasised that this can be mediated by civil society organisations active within farmers' communities. Such third party support *"facilitates clear communication between project proponents and farmers, increase farmers' bargaining power in negotiations, and reduces transaction costs"* (Tamba et. al., 2021).

This short study found that, increasingly, more and more ambitious GHG-related commitments from the private sector are leading to the fast development of new technologies (e.g., use of satellite data, machine learning, etc.), which may soon offer very simple interfaces and ready-to-use data that may increase smallholder farmers' agency and enable them to seek and obtain benefits from selling carbon credits. Policies at different levels may create more pressure on companies in the food and agri sector to remove Scope 3 emissions, and to engage in insetting, rewarding of farmers, and growing of the voluntary market for carbon credits.

Participation of farmers in carbon markets, although guided in different standards in terms of processes for engagement and design of projects, does not yet include their participation in price setting. Methods to quantify the costs for farmers, to value their work, and to value ecosystem services and carbon credits, vary widely both in number and in complexity. The literature reviewed and the cases studied highlight these challenges, and show that innovative private actors in tight, direct supply chains, are driving farmers' participation. The mechanism and conditions under which smallholders are involved, and the costs and benefits, are difficult to understand due to the complexity of carbon markets and the diverse standards and methodologies used. In this regard, climate sensitive development financing can be an important instrument in supporting smallholder involvement in climate change mitigation.

The three cases studied showed that carbon payments vary widely and are relatively low, which confirms the review of 10 similar projects from Tamba et. al. (2021). Future studies

and projects must also consider, and perhaps monetise, the other benefits which may incentivise smallholders' participation, such as crop and income diversification, benefits to soil, or increases in productivity.

A World Bank Report estimated that to meet the climate goals set out in the Paris Agreement, emission credit prices need to be between USD 40-80 by 2020 (World Bank, 2019). By comparison, credits being used in the pilots presented in this study are for prices far too low to drive down emissions. If GHG emissions are to be regulated, then the prices of carbon need to increase, giving a greater economic incentive to smallholders to participate in the carbon market.

Closing note from CFC

CFC has been supporting two of the three case studies presented in this paper. It signed a Loan Agreement with Colcocoa in 2021, for the amount of USD 1.1 million. The disbursement is expected for 2022. To know more about CFC's engagement with Colcocoa and how it is supporting smallholders to thrive in the climate crisis, please visit https://www.common-fund.org/cafexport-hacienda-la-tentacion-cocoa-colombia. CFC has been supporting Kennemer since 2017 with a loan of USD 1.4 million. For more information on Kennemer, please go to page 71 of this Annual Report.

CFC aims to contribute to bringing more income for smallholders in a sustainable and climate friendly way, and to build robust partnerships with the likes of Colcocoa, Carble, Kennemer etc. CFC is aware of the challenges in understanding the mechanisms, drivers and decision-making processes that affect smallholder farmers' participation in carbon markets and, as such, will work harder to provide more comprehensive reviews of literature and systematic analysis of case studies in the future.

It is proven beyond doubt that agriculture can reduce emissions more cheaply than large emitters such as energy schemes. In agriculture, smallholders can reduce carbon emissions by reducing stocking rates or changing from conventional to reduced or no tillage production. This comparative advantage of agriculture and smallholders needs to be factored in as climate experts increasingly develop agri-friendly tools and technologies. CFC welcomes proposals for investments in such innovative pilots to play its role in not only reducing GHG emissions, but also to providing farmers with more avenues to augment their income by selling carbon offsets.

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Photo: Colcocoa