Completion Report

Impact at origin: Catalyzing sustainable agriculture with smallholder farmers – Nicaragua
NCF 9 Project No NCF-C9-1206

Grantee: Arvid Nordquist

Local Partner(s): APRODEIN, Taking Root, U&We

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Date

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1. EXECUTIVE SUMMARY

The world is losing its forests because people see more opportunity in cutting down trees than growing them. The land stewarded by smallholder farmers collectively represents one of the biggest opportunities to restore the world's forests. However, farmers often face barriers to making land-use choices in favour of growing trees. Corporate actors such as coffee brands who want to meet climate targets could represent a solution. In the coffee sector alone, actors have pledged to reduce and remove at least 1.5 gigatonnes of carbon by 2050[1]. Corporate actors investing in meeting these climate commitments could provide a pathway to finance and incentivise smallholder farmers to improve their livelihoods by growing trees while contributing to climate solutions.

Arvid Nordquist is a Swedish Coffee roaster which has had a focus on reducing its carbon emissions for over ten years. In addition to the emission reduction measures the company has taken over the years the roastery has also been carbon offsetting for the emissions that remain mainly in tree planting projects in Nicaragua. Arvid Nordquist has a commitment to reduce its emissions in line with the Paris agreement and wants to find measurable ways to cut emissions of the farming of the coffee within its supply chain so that these emission reductions that can be used to meet its climate targets. The challenge over the years has been how to collect and receive reliable data to understand what the most effective emission reduction interventions would be and quantify their impact in order to make robust claims.

However, for smallholder farming groups, access to financing from corporates - like Arvid Nordquist - seeking to meet their climate commitments is often out of reach. It is too costly and complex to successfully manage and report on forest restoration activities and their impacts across fragmented smallholder landscapes to the level required for corporate actors to invest. The Impact at Origin project set out to create a replicable solution for coffee brands to invest in climate impacts with smallholder coffee farmers. This would connect coffee brands with investible and verified forest and climate impacts to improve and build resilience for millions of farmers' livelihoods while mitigating climate change and helping companies deliver on their climate targets.

By using Taking Root's technology (formerly FARM-TRACE) to create verified farm-level impact reporting, the Impact at Origin project, in collaboration with sustainability consultant U&WE and implemented by local partner, APRODEIN, and arvid Nordquist's coffee sourcing partner, Ecom, has achieved the following:

- Successfully mapped 1,420 hectares of coffee farmland within the Arvid Nordquist supply chain, along with an additional 107 hectares where climate-smart project interventions were introduced. This data enables Arvid Nordquist to establish traceability and transparency, facilitating the tracking and verification of impacts over time.
- Generated baseline forest inventories across 1,420 hectares using inventory data collected by ECOM and APRODIEN. This dataset can be used to track the impact of interventions over time.

[1] BusinessGreen; Global coffee players brew up 2050 climate plan to slash 1.5 gigatonnes of CO2

- Implemented climate-smart farming practices across 107 hectares, including the planting of 316,253 (21,494 shade and 7,294,759 coffee) trees across 60 parcels. The project is expected to result in 19,541 tCO2 emission reductions once the trees mature into forests.
- Developed and applied a carbon calculator to quantify the farm-to-port footprint of 15 producers in Arvid Nordquist's supply chain. Depending on which coffee farms supplied Arvid Nordquist for the year, these results can be used to connect to Arvid Nordquist's corporate climate footprint.
- Trialled the potential of biochar amendments as an alternative to fertilizer across 5 farms to enhance plant growth while sequestering additional carbon through optimizing fertilizer usage.

The project has enabled significant investments into Taking Root's software platform and accompanying training materials in order to help smallholder farmers access the carbon market through forest restoration. The main lesson learned through the project for Taking Root was that a standalone technology solution is not enough to plant and grow trees effectively to the standard the impact market requires. To achieve its mission of accelerating the restoration of the world's forests, Taking Root needs to support local partners through services as well as technology. In addition, the most effective market mechanism to drive the financial sustainability of this work is through the creation and sale of certified carbon credits to corporate actors seeking to meet their climate commitments. As such, moving forward, Taking Root is focusing on building certified forest carbon projects with local implementing partners.

For this particular project, the next steps will be for Arvid Nordquist to assess how they would like to move forward with carbon reduction and carbon removal activities and tracking within its supply chains. For Taking Root, it has already begun scaling its solution globally and across commodities. It is continuing to expand its forest restoration activities across Nicaragua and is currently designing a forest carbon removal project to enable smallholder cacao farmers in the Dominican Republic to access the carbon market by growing trees.

2. ACHIEVEMENT OF RESULTS

2.1 Achievement of outcomes and output

Original Milestone deliverable	Total original project target	Revised Milestone deliverable/ target	Achieved Milestone Target	Completed (Yes/No/ Partially)	Results	Update
Outcome 1.1: 18,000 tCO2 of reduced emissions from improved climate smart farming practices by smallholder coffee farmers within Arvid Nordquist's Nicaragua supply chain.						
1.1 Outcome indicator: Greenhouse Gas Emissions Reductions	18,000 tCO2	14,000 tCO2	383t CO2	Yes	Based on 107.5 hectares of land being restored it is estimated that around 19,541 tCO2 would be sequestered if those trees mature into forests over the next 20 years. During the active implementation of this project, 383t of CO2 reductions have been calculated. This does not include carbon sequestered through biochar applications on parcels or through any other potential emissions reductions in future years resulting from the project.	NA

1.1.1 Output: 1400 ha coffee farms within Arvid Nordquist's Nicaragua supply chain is mapped in FARM-TRACE	1,400 ha	No change	1,527 ha	Yes	During M1: 485 ha During M2: 1,042 ha	A total of 1,527 hectares were mapped using Taking Root's technology platform, representing an additional 107 ha were mapped over and above the original target.
1.1.1.1 Activity: Scoping workshops to understand Arvid Nordquist and sourcing partners supply chain reporting practices and requirements	1	No Change	1	Yes	Workshop completed in Milestone 1	NA
1.1.1.2 Activity: Identify and setup each Producer Cooperative within Arvid Nordquist's chain in FARM-TRACE	1	No Change	1	Yes	FARM-TRACE Program for Ecom setup in Milestone 1	NA
1.1.1.3 Activity: Create FARM-TRACE implementation plan with Arvid Nordquist sourcing partners and Producer Co-operatives	1	No Change	1	Yes	FARM-TRACE implementation plan created with Arvid Nordquist and Ecom in Milestone 1	NA
1.1.1.4 Activity: Train and support sourcing partners and producer co-operatives to register all farmers and map every farm within their coop using the FARM-TRACE mobile app or through bulk upload	3	No Change	3	Yes	3 trainings provided to Ecom on 1) program setup, 2) parcel mapping and 3) field monitoring in Milestone 1. These trainings were delivered to 13 field technicians, 9 male and 4 female. A refresher training on mapping was provided in Milestone 3 to 4 Ecom staff, 3 men and one woman.	Additional training on mapping with the Taking Root application was provided to ECOM during M2 as part of the brand change from Farm-Trace to Taking Root technology. Training was provided to 4 Ecom staff, 3 men and one woman.

1.1.1.5 Activity: Farmer registration and farm mapping through FARM-TRACE	1,400 ha	No change	1,527 ha	Yes	During Milestone 1: 485 ha During Milestone 2: 1,042 ha	See update above for 1.1.1.
1.1.1.6 Activity: An E&S Assessment is created and approved by NCF	1	No change	1	Yes	Complete - Assessment approved by NCF	NA
1.1.2 Output Indicator: Arvid Nordquist have forest carbon and fertlizer emissions reporting across 1,400 ha of mapped farms	100%	No change	100%	Yes	Forest carbon baseline completed for 1,420 ha of land. Pilot results produced for assessing carbon emissions across a representative sample of coffee parcels.	A carbon baseline was completed for 1,420 ha of forests and results were shared with project partners. Fertilizer emissions reporting was completed, and final calculations were provided by U&We. The emissions calculator covers: 1) The farm-to-port footprint of 15 producers in the 2021 pilot program for coffee production. 2) Carbon emission pools: Transport, Water and Waste treatment, Energy use (non-transport), Fertilizer and pesticides Results show 1,052tCO2e or ~1.01kgCO2e/kg coffee or 14tCO2e /ha emitted for the pilot year. These results can be extrapolated as required across similar coffee producing parcels.

1.1.2.1 Activity: Forest classes across mapped parcels assessed to create a targeted monitoring plan	Yes	No change	Yes	Yes	Monitoring plan created for all mapped parcels	All mapped parcels were assigned a management unit (forest class) in the Taking Root platform. Each forest class is evaluated to create a sampling frame which assigns the number and size of monitoring plots for each parcel. This is a semi-automated process done by the Taking Root technology that balances statistical significance with field practicality to create a monitoring plan.
1.1.2.3 Activity: Training with sourcing partners and producer co-operatives on how to gather forest inventory and fertilizer emissions data	1	No Change	1	Yes	Training delivered	Training completed with Ecom on field inventories and gathering fertilizer emissions data using the calculator created by U&We. Training was provided to 4 Ecom staff, 3 men and 1 woman. Example of the training materials created are here.
1.1.2.4 Activity: Forest inventory data is collected by field staff across vegetation cover classes as inputs to calibrate FARM-TRACE's machine learning algorithm	1	No Change	1	Yes	Forest inventories completed	Completed through baseline forest inventories by Ecom and by gathering data across Nicaraguan landscapes by APRODEIN.

1.1.2.5 Activity: Fertilizer emissions data is collected by field staff across source farms	Yes	No Change	Yes	Yes	Fertilizer emission data collected across 15 producers	Questionnaires detailing fertilizer use and emissions from farms that are part of the Arvid Nordquist supply chain were completed by producers and collected by field staff. The results of these surveys can be found in the carbon calculator within the supporting materials.
1.1.2.6 Activity Forest cover and fertilizer emissions reporting generated across source farms with continuous forest cover and carbon reporting generated automatically in FARM-TRACE	1,400 ha	No Change	1,420 ha	Yes	Reporting completed	Ability to generate estimates of forest cover and carbon sequestration through the software platform implemented. These estimates are generated upon the completion of forest inventories through the mobile application.
1.1.2.7 Activity: Land-use emissions reporting connected to Arvid Nordquist corporate climate footprint	Yes	No Change	No	Completed	Results show 1,052tCO2e or ~1.01kgCO2e/kg coffee or 14tCO2e /ha emitted for the pilot year.	Carbon calculator results delivered to Arvid Nordquist and Ecom through U&We. Fertilizer emissions reporting was completed, and final calculations were provided by U&We. The emissions calculator covers: 1) The farm-to-port footprint of 15 producers in the 2021 pilot program for coffee production. 2) Carbon emission pools: Transport, Water and Waste treatment, Energy use (non-

						transport), Fertilizer and pesticides Results show 1,052tCO2e or ~1.01kgCO2e/kg coffee or 14tCO2e /ha emitted for the pilot year. Depending on which coffee farms sourced Arvid Nordquist for the year, these results can be used to connect to Arvid Nordquist's corporate climate footprint. Further work will be required if these results are to be fully incorporated into Arvid Nordquist's corporate climate footprint.
1.1.3 Output Indicator: Arvid Nordquist ensures the $4m it currently spends on its Nicaragua coffee supply chain only supports zero deforestation farms	100%	No change	No	Not Completed	No	While the results of this project provide forest carbon baselines across 1,420 ha of land, this does not guarantee that Arvid Nordquist's annual purchase of coffee comes from those parcels or that those parcels are zero deforestation. This information will need to be provided on an ongoing basis in the future by Ecom and may require additional reporting depending on the year and the farms from which Arvid Nordquist sources from for that particular year.

1.1.3.1 Activity: Training for Arvid Nordquist procurement teams and sourcing partners to understand forest and carbon and fertilizer emissions reporting	1	No change	1	Partially – to be completed on 15th August	A report detailing the forest carbon baseline for 1,420ha of forests was delivered and presented to Arvid Nordquist.	U&We have completed the carbon emissions calculator with results outlined in the attached documentation. Taking Root has run through the results with Arvid Nordquist and NCF on 15th August 2023. If further training is required, knowledge sharing is recommended directly from U&We to Arvid Nordquist and Ecom if they would like to interpret or use the results further.
1.1.3.2 Activity: Workshops with Arvid Nordquist marketing and sustainability teams on how to use reporting to track against corporate targets, enhance product marketing and implement improvements	1	No change	No	Partially – to be completed on 15th August	Outline to be provided on August 15th on advice for how Arvid Nordquist can use similar activities from this project to make corporate claims in the future. The main claims generated from this project are: - The restoration of 107.5 ha of land - 316,253 (21,494 shade and 294,759 coffee) trees planted	NA

1.1.3.3 Activity Gather feedback to integrate and enhance FARM-TRACE reporting for Arvid Nordquist decision-making and value creation.	Yes	No change	NA	Partially	Results and data package delivered as part of the final package of grant reporting.	Any feedback will be received during the end of project meeting on 15th August to be incorporated into future work and projects.
1.1.4 Output indicator: Implement climate smart farming practices to increase forest cover and reduce fertlizer emissions on Arvid Nordquist's source coffee farms	90 ha	No change	107.5 ha	Yes	107.5ha **total** intervention Tree-planting: 107.5ha Biochar experiment: 2.4ha on tree planting intervention areas on which 234kg of biochar were added as an input to the farms. Details of these interventions can be found in the letter previously submitted to NCF.	NA
1.1.4.1 Activity Workshops with Arvid Nordquist, sourcing partners and producer co-operatives to identify emissions removals and fertilizer reductions opportunities	1	No change	1	Yes	Workshops were held with ECOM, Arvid Nordquist's sourcing partner to determine best types of interventions. Taking Root presented two interventions for emission removal opportunities to NCF and submitted a letter detailing findings.	NA
1.1.4.2 Activity Create climate smart farm plans with sourcing partners and producer co-operatives to implement climate smart farming practices	1	No change	1	Yes	Worked alongside ECOM to develop climate smart farming plans as part of the project interventions through reforestation activities and experimentation with inputs for coffee agroforestry systems as outlined in the letter submitted to NCF.	NA

1.1.4.3 Activity Provide training in different climate smart farming interventions including best-practice agroforestry techniques, reforestation and alternative fertilizer regimes.	1	No change	1	Yes	Refresher training on monitoring Weekly meetings on progress	NA
1.1.4.4 Activity Roll out climate smart practices including increasing shade cover on existing coffee farms, reforesting underused land, reducing fertilizer usage and providing climate friendly alternatives to existing fertilizers such as biochar.	90 ha	No change	107.5 ha	Yes	Yes. The interventions were split into 3 categories: A) Reforestation [19.06ha] – planting native tree species to improve climate resilience across coffee landscapes which Arvid Nordquist sources from B) Coffee agroforestry [86.01ha] – planting native tree species alongside coffee to provide shade and build on-farm resilience to generate potential future coffee supply from sustainable sources for Arvid Nordquist C) Coffee agroforestry research [2.4ha] – planting native tree species alongside coffee and using different mixes of biochar and fertilizer to assess the optimal input regime to maximise coffee yields for farmers while reducing CO2 emissions.	NA

Outcome 1.2: Increased incomes worth Euros 1.1m generated across 700 smallholder coffee producers						
1.2.1 Outcome Indicator Total farmers engaged in the project	700 farmers	No change	365	Partially	365 people were engaged through the project. Out of this number, 73 farmers had their parcels mapped using the TR technology and 25 who owned the land upon which interventions were conducted.	NA
1.2.2 Outcome indicator. Increased Income for Producers	1.1 million euros	No change	NA	No	NA	The project has not been able to calculate the total increase in income for producers. However, it has received feedback and anecdotal evidence that: - Participating producers in the research trial parcels using mixes of biochar and fertiliser reported lower costs relative to using fertilizer only treatments. - The producers who implemented coffee agroforestry planting have more climate resilient parcels in the cace of heat increases expected over the coming years from changes in the climate. The exact amount will only be

						possible to assess over time. - In the future if Ecom were to commercialise the carbon being sequestered through the project they could generate revenues of Euros 322,500 (assuming an average price of 20 euros per tCO2). However, further work would need to be conducted to assess the feasibility of commercialising the carbon and its value. - In addition, it is anticipated producers engaged in this program will produce coffee harvests improving incomes by around 50,000 euros annually (see outcome 1.2.2)
1.2.1 Output Indicator Producers adopt long term climate adaptation techniques	2 organizations	1 organization	1	Yes	Advice and training given to Ecom on techniques to enable higher likelihood of success of farmers implementing climate adaptation techniques such as tree planting and growing.	NA

1.2.1.1 Activity Training with sourcing partners and producer co-operatives to build capacity in best-practice agroforestry techniques and how to optimise shade cover over time	1	No change	1	Yes	A training was provided on best-practice agroforestry techniques to Ecom alongside weekly meetings to provide ongoing advice and knowledge sharing.	NA
1.2.1.2 Activity Training and systems integration scoping with producer co-operatives and sourcing partners to connect coffee harvest data with farm climate data to identify opportunities for farm climate adaptation optimization	1	No change	1	No	An assessment was conducted of Ecom's current software monitoring and reporting approaches. It was concluded it would not make sense at this stage to integrate the data collected from the project with Ecom's systems. As Ecom collects more climate data in the future, this is something they may wish to consider.	NA
1.2.1.3 Activity Connect existing producer harvest data with FARM-TRACE climate data for analysis on optimal farming practices for yield and climate outcomes.	Yes	No change	NA	No	NA	See update on 1.2.1.2. It was agreed given the amount of work required and the small amount of data generated through the project, it would only make sense once Ecom has established, regular data collection on climate adaptation adoption and results.

1.2.2 Output Indicator Improved producer sales and investment from sustainable production	100,000 euros	No change	53,538 annually	Partially	Completed	The project planted 88.41ha of coffee agroforestry forecast to produce 76,483 kg of coffee annually. Based on current prices ($0.70/kg) this will deliver ~$865kg per ha. Having restored 88.41ha it is anticipated this will generate $53,538 for coffee producers who have taken part in the project from future coffee production.
1.2.2.1 Activity: Training with farm co-operative marketing, sales and management teams to help demonstrate how reporting can support product differentiation and sales.	1	No change	1	Yes	Several meetings were delivered to Ecom to establish how they could use Taking Root techniques and reporting to meet corporate sustainability and climate needs. This included: - How to substantiate insetting and offsetting claims - Different reporting approaches to achieve intended outcomes	NA
1.2.2.2 Activity: Training with sourcing partners to market claims on behalf of farm co-operatives to prospective clients	1	No change	1	Yes	See Activity update for 1.2.2.1	NA

1.2.2.3 Activity: Support for producers and sourcing partners to create investment pitches for sustainable outcomes including scoping the potential of generating certified carbon credits	1	No change	1	Yes	NA	Taking Root gave advice to Ecom on how to generate carbon credits and effective strategies to achieve that aim.
1.2.3 Output Indicator: Reduced fertilizer usage through optimised applications	4% reduction	25% on 2 ha 50% on 2 ha	50% on 2.4 ha	Yes	NA	These changes were highlighted in the letter requested for approval of interventions submitted in May 2022. This intervention was scoped to include 4ha, however based on availability at the time of selecting and visiting producer participants, the 5 treatment parcels amounted to 2.4ha. 50% reduction of fertiliser was applied to each of these parcels and combined with varying applications of biochar. Aside from reducing fertiliser costs by 50%, varying applications of biochar resulted in differences in tree growth, vigor and disease resistance across treatment parcels. ECOM will continue to monitor the outcomes of the biochar experiments, assessing the potential for scaling these implementations across various parcels.

1.2.4 Output Indicator Cost savings through program efficiency gains and automated reporting	50 days time saved	No change	NA	No	NA	It was learned through the project that many of the monitoring techniques adopted through the project were additional to previous techniques adopted by Ecom. Therefore, the project did not create savings and efficiency gains. Instead, it provided information for Ecom to be able to assess if the value created through the activities of the project were worth the costs of implementing them.
1.2.4.1 Activity Scoping with sourcing partners and farm certifications including Rainforest Alliance to assess compliance and reporting needs.	1	No change	1	Yes	Taking Root's forest carbon reporting has been aligned with best practice third party standards (i.e. Plan Vivo). The carbon calculator was designed and created in line with Rainforest Alliance's recommendations and best-practices.	NA
1.2.4.2 Activity Integrate where possible, Rainforest Alliance data collection and reporting requirements within FARM-TRACE	Yes	No change	Yes	Yes	An evaluation of Rainforest Alliance data collection and reporting requirements was conducted. These were integrated into the carbon calculator built by U&We.	NA
1.2.4.3 Activity FARM-TRACE training with sourcing partners' administration / certification teams	1	No change	1	Yes	See update 1.2.2.3.	NA

2.2 Deviations from the planned outputs and activities

Originally when the Impact at Origin project was envisioned, the partners had anticipated three types of possible interventions: a) tree planting b) fertilizer switching c) biochar applications. The intention was to conduct baselines and analysis to design a series of interventions most suited to meeting farmer objectives and deliver the project's carbon removal goals. At the project's outset, there was a lack of knowledge about the optimal distribution of these interventions or their precise costs. Consequently, the initiation of the project relied on informed estimations to allocate costs across these categories.

However, after completing parcel mapping and developing a forest baseline through field monitoring using the Taking Root technology, it was determined that the initially selected coffee agroforestry systems have mature forest cover, thus additional tree density would be detrimental to production and likely unsuccessful for carbon capture. Analysis of the baseline results helped to identify alternative areas that are under-utilized within the same landscape for future agroforestry interventions incorporating coffee, cattle, or other commodities. These results informed where the greatest impact with farmers and land within Arvid Nordquist's coffee supply chain would be, and enabled us to tailor the design of interventions accordingly.

The proposed interventions were well aligned with the original goals and conception of the Impact at Origin project. The interventions were split into 3 categories as per the table below.

Intervention: Management Unit	Description	Target Intervention Area (ha)	Actual Intervention Area (ha)	Actual Parcels (number)	tCO2 to be removed over 10 years
Research + Planting: Investigación Agroforestal del Café	Planting native tree species alongside coffee and using different mixes of biochar and fertilizer to assess the optimal input regime to maximise coffee yields for farmers while reducing CO2 emissions.	4.19	2.4	5	2,377.50
Planting: Reforestacion	Planting native tree species to improve climate resilience across coffee landscapes which Arvid Nordquist sources from	15.85	19.06	5	11,106.48
Planting: Cafe Agroforestal	Planting native tree species alongside coffee to provide shade and build on-farm resilience to generate potential future coffee supply from sustainable sources for Arvid Nordquist	84.14	86.01	50	553.08

As a result of these updates the following outputs/activities and targets were revised. See table below for a summary and update on results achieved:

Original Milestone deliverable	Total original project target	Revised Milestone deliverable/target	Results Achieved
Outcome 1.1: 18,000 tCO2 of reduced emissions from improved climate smart farming practices by smallholder coffee farmers within Arvid Nordquist's Nicaragua supply chain.			
1.1 Outcome indicator: Greenhouse Gas Emissions Reductions	18,000 tCO2	14,000 tCO2	The amount of impact that can be created is based on the appropriate land available for interventions and farmer interest. Based on 107 hectares of land being restored, it is estimated that around 19.541 tCO2 could be sequestered if those trees mature into forests. This does not include carbon sequestered through biochar applications on parcels or through any other potential emissions reductions in future years resulting from the project. Consequently, the amount of emissions reductions achieved will exceed the revised target of 14,000 tCO2.
Outcome 1.2: Increased incomes worth Euros 1.1m generated across 700 smallholder coffee producers			
1.2.3 Output Indicator: Reduced fertilizer usage through optmised applications	4% reduction	25% on 2 ha 50% on 2 ha	At the beginning of the project it was not known what the interventions would be. It was originally anticipated that reduced fertilizer applications would play a larger role in interventions. As such an average of a 4% reduction was selected as a realistic goal to be achieved across parcels receiving interventions. However, through the work completed in phase 1 of the project the interventions designed to focus specifically on fertilizer reductions were relatively small. This is because a) there is more immediate opportunity for impact through growing trees b) the impact of alternative fertilizer regimes is unknown. As such the area selected and reductions were designed as research to inform future possible fertilizer regime changes to deliver emission reductions. Aside from reducing fertiliser costs by 50%, varying applications of biochar resulted in differences in tree growth, vigour and disease resistance across treatment parcels. ECOM will continue to monitor the outcomes of the biochar experiments, assessing the potential for scaling these implementations across various parcels.

The project was unable to achieve Output Indicator 1.1.3 'Arvid Nordquist ensures the $4m it currently spends on its Nicaragua coffee supply chain only supports zero deforestation farms'. While the results of this project provided forest carbon baselines across 1,420 ha of land, this does not

guarantee that Arvid Nordquist's annual purchase of coffee comes from those parcels or that those parcels are zero deforestation. This information will need to be provided in the future by Arvid Nordquist's coffee sourcing partners and may require additional reporting depending on the year and the farms from which Arvid Nordquist sources from for that particular year.

2.3 Achievement of NCF indicators

NCF core indicator	Cumulative progress (number)			Clarifications/Means of verification
Number of beneficiaries reached	Women		6	Taking Root web application (previously Farm-Trace).
	Men		23	
	Unspecified		336	
	total		365	
Number of people with increased resilience to climate change	Women		6	Taking Root web application (previously Farm-Trace).
	Men		23	
	Unspecified		336	
	total		365	
Number of people with improved livelihoods	Women		6	Taking Root web application (previously Farm-Trace).
	Men		23	
	Unspecified		336	
	total		365	
New decent jobs created	full-time	women	4	• Ecom staff working on the project • Taking Root staff working on the project • APRODEIN staff working on the project
		men	9	
		total	13	
	part-time	women	0	
		men	0	
		total	0	
	seasonal	women	0	
		men	0	
		total	0	

3. CLIMATE CHANGE

In summary, the project has delivered:

- 107.5 ha of land being restored
- 316,253 trees planted
- 19.541 tCO_2 forecast to be sequestered
- Initiated trials which could see fertilizer reductions of up to 50% for coffee farmers

Context:

In the first phase of the project the baseline was established by mapping all the farms within Arvid Nordquist's supply chain and conducting forest inventories. Taking Root technology's machine learning algorithms correlated the forest inventory measurements with continuous satellite imagery feeds to infer carbon sequestration on each pixel over each farm. In the second phase of the project, ECOM delivered capacity building activities to help producers adopt climate-smart production practices with regards to increasing forest cover on parcels and trailing fertilizer applications to reduce agricultural emissions and promote agricultural adaptation. This project planted a total of 316,253 (21,494 shade and 7,294,759 coffee) trees across 60 parcels delivering adaptation and mitigation co-benefits for 25 producers.

Increasing forest cover on farms is a powerful climate change mitigation and adaptation strategy aligned with Nicaragua's NDCs. From a mitigation perspective, just 5% increase in tree density across Nicaragua's 126,000 hectares of coffee-land could sequester 1,000,000tCO2. This is critical in a country where between 1983 and 2015, it has lost 50% of its forest cover[2] and where farming is the largest source of GHG emissions[3].

Mitigation outcomes

Based on 107 hectares of land being restored, with 316,253 trees planted it is estimated that around 19,541 tCO2 could be sequestered if those trees mature into forests. This is based on an estimate of around 150tCO2 being sequestered per hectare over the next 20 years and excludes carbon sequestered through biochar applications on parcels or through any other potential emissions reductions in future years resulting from the project.

Adaptation outcomes:

From an adaption perspective, Nicaragua's coffee is grown by 44,000 farmers, employing 15% of the labour market[4]. However, it is extremely susceptible to climate change with 90% of Nicaragua's coffee growing areas predicted to be negatively affected by 2050 due to rising temperatures[5]. While further analysis would need to be undertaken to quantify the benefits of reforestation, literature suggests that increasing forest cover on farms can decrease on-farm temperatures from 2-6^oC[6] improving agricultural resilience to warming temperature and preventing large yield declines.

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[2] https://www.marena.gob.ni/Enderedd/wp-content/uploads/Fases/2.%20Estudio%20Causas%20Desforestaci%C3%B3n%20y%20Degradaci%C3%B3n%20Forestal.pdf

[3] https://unfccc.int/sites/default/files/NDC/2022-06/Contribucion%20Nacionalmente%20Determinada%20Nicaragua.pdf

[4] HTTPS://APPS.FAS.USDA.GOV/NEWGAINAPI/API/REPORT/DOWNLOADREPORTBYFILENAME?FILENAME=COFFEE%20ANNUAL_MANAGUA_NICARAGUA_6-13-2017.PDF

[5] https://link.springer.com/article/10.1007/s10584-016-1788-9?dom=icopyright&src=syn

[6] https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0006487

4. DEVELOPMENT IMPACTS AND CROSS-CUTTING ISSUES

In summary:

- Improved farmer livelihoods by supporting new sustainable coffee production for producers which could unlock +$50,000 in new income annually
- Local economic development by supporting the creation of 6 jobs locally in Nicaragua to support forest restoration activities
- Increased farmer climate resilience with 25 farmers and their families (around 75 people) with new resilient shade coffee plantations
- Created tools to drive gender equity. Project has generated a dataset to provide transparency into gender equality across coffee producers. And in a country where male land ownership is typical, the project's beneficiaries were made up of 25% women.
- Built local capacity and knowledge sharing with local teams in best practice agroforestry and monitoring and reporting to achieve sustainability outcomes.

Context:

Nicaragua is the second poorest country in the Americas[7] and is one of the most at-risk countries from the effects of climate change. With close to 30% of its population dependent on agriculture, it is extremely vulnerable to extreme flooding and droughts[8]. This project directly aligned with Nicaragua's development strategy. Its NDC and National Human Development Plan aim to tackle poverty and inequality through investment in "capacity development, access to technology and financing in the agricultural sector"[9] as well as prioritizing natural environmental protection for agricultural production such as increasing tree cover on farms.

Outcomes

- **Improved farmer livelihoods:** The project restored 88.41 of new coffee agroforestry by planting shade trees alongside coffee trees. These new coffee agroforestry plantations will help coffee producers unlock new coffee harvests worth over +$50,000 annually. This will bring increased financial resilience and improved livelihoods to the farmers involved in the project.
- **Local economic development:** The project has supported the creation of 6 full time local roles which will be continued beyond the project. These roles are all focused on sustainable land-use practices and digital monitoring, reporting and evaluation.
- **Increased farmer climate resilience:** 107.5 ha of land was restored through the planting of coffee agroforestry and shade trees across coffee landscapes. 25 farmers and their families (around 75 people) now have improved climate resilience for coffee production in the context of rising temperatures and more volatile weather due to climate change.
- **Created tools to drive gender equity:** The project has generated a dataset to provide transparency into gender equality across coffee producers. By developing and leveraging traceable and transparent datasets through digitizing farmer, parcel and impact data, the project has the potential to improve yields for participating farmers by targeting customized interventions and support from farm co-operatives, Arvid Nordquist, and local financial institutions. Additionally, gender disaggregated data across 1440 hectares of coffee

[7] https://www.imf.org/external/np/ins/english/capacity_countries_mfs_nicaragua.htm
[8] https://www.germanwatch.org/en/16046
[9] https://unfccc.int/sites/default/files/NDC/2022-06/Contribucion%20Nacionalmente%20Determinada%20Nicaragua.pdf

farmland can also be used to promote equality by identifying gaps and bridging these using equitable payments and services. In addition, in a country where male land ownership is typical, the project's beneficiaries were made up of 25% women.

- **Built local capacity and knowledge sharing with local teams**: Throughout the project, there was ongoing knowledge sharing in best practice agroforestry and monitoring and reporting to achieve sustainability outcomes. This was achieved through formal workshops and meetings as well as ongoing working collaboration.

5. ASSESSMENT OF THE RESULTS AND IMPACTS OF THE PROJECT

5.1 Relevance

The results of this project are relevant to actors across the coffee sector which is investing 350M USD annually in a variety of sustainability efforts[10]. The learnings and results help demonstrate and provide guidance on how to implement potential climate mitigation strategies to remove carbon from the atmosphere. At the same time, many of the activities within the project could contribute to adapt to climate risks in the coffee sector including the growth of coffee agroforestry to restore historically degraded landscapes, reducing water stress, and improving coffee yields in the face of rising temperatures.

In terms of the relevance specifically to Nicaragua, the answers under section 3. and 4. outline how the project is line with national policies/strategies as well as respond to current land-use challenges and changes in climate. Content under section 2.2. outlines how the project adapted to the local needs of producers to ensure value to them, while creating positive climate outcomes.

5.2 Effectiveness

The major outcomes of the project were achieved:

a) **Parcel digitization:** The digitization of climate impacts across the project areas was achieved across 1,527ha, a greater area of land than initially set out of 1,400 ha.

b) **Restored land:** The restoration outcomes of the project were largely achieved with the area of land restored of 107.5 ha, greater than the target of 90ha.

c) **Carbon removal:** The target carbon impacts in large part was achieved, with 19,541 tCO_2 forecast to be sequestered.

There were two main areas which fell short of initial outcomes:

a) **Farmer engagement:** The project did not reach as many farmers as it initially anticipated. The original target of people reached was 700. The project engaged 365 people. This was because farmers who participated in the project had a larger average parcel size than initially predicted.

b) **Time savings:** The project focused on value and impact creation rather than time savings. Originally the project set out to save 50 days of time from the local implementer. It was discovered that many of the activities involved in the project were not being done already by the local implementer. As such, the project became an exercise in assessing value/impact creation through additional activities rather than resource and cost savings.

[10] https://www.sustaincoffee.org/framework-detail

5.3 Efficiency

As highlighted under section 5.2, the project ended up creating new activities for the project's local implementer rather than bringing efficiency to pre-existing activities. In introducing these new activities, substantial thought went into ensuring these activities could be implemented in a cost-efficient and effective way. Some of these are outlined below:

- **Pre-identification of parcels for interventions:** During the first phase of the project, producers and parcels were identified as being suitable for project interventions to avoid additional producer visits and consultations. This was achieved through building an understanding of the local implementer's pre-existing knowledge of appropriate regions, producer consultations when mapping their land, and evaluating the results of the parcel baselines. This enabled interventions to be targeted where they could be most valuable for producers and most effective within the landscape.
- **Efficient data collection practices:** During the project numerous features were released to make data collection more effective and efficient. For example, a feature was released whereby multiple technicians could collect data from the same parcel. This made staff planning easier for data collection activities.
- **Focus on quality data collection:** One of the most time-consuming activities for data collection is cleaning up the data after it has been collected. It is much more time effective to ensure high quality data collection up front. As a result, during the course of the project a number of features and processes were introduced to enhance data quality. This included building in visuals into the Taking Root mobile app to help instruct users on data collection as well as Quality Assurance and Control processes to check and verify data once collected.

Due to these focus areas, it meant local implementation costs were able to be maintained in line with the original budget. It I also worth noting that the project was delivered on time without any extension. This was delivered through efficient project management and partnership across the implementing organizations in the project.

5.4 Impact

There are several higher-level effects from the project which will be better understood in future years.

- **Changing the perception of trees with farmers:** Land-use norms and trends in Nicaragua has meant farmers have been used to clearing trees rather than growing them. In communities, part of what enables more sustainable practices is to see them being adopted with other farmers. By implementing this project, it is a start to shifting farming norms across the landscape, which will lead to increased normalisation of growing trees alongside current agricultural practices and the perspective that climate friendly activities could be a source of additional economic value for farmers.
- **Creating a platform to enable forest restoration and carbon removal:** Beyond the application within this project, the investment into Taking Root's platform will do two things; 1) Make it easier to grow trees with local implementers in different geographic regions. This is due to better training resources, documentation, and ease of use of the technology platform which have been created as a result of the project 2) Increase trust and investment into carbon removal. The project has helped Taking Roots create the methods,

documentation and reporting needed to build trust in natural climate solutions as a path to carbon removal. This is having impacts beyond this project across all the work Taking Root is doing.

- **Adapting investment from the coffee sector based on local contexts:** One of the learnings from Arvid Nordquist during this project is that one project type doesn't fit all (regions) in order to create effective and long-term impact. Local needs and market context need to be assessed in order to evaluate and effectively invest in solutions which benefit the climate and deliver value from a business perspective.

5.5 Sustainability

- **Forest restoration and carbon removal:** The project has helped to restore 107.5 hectares. These interventions were designed in line with farmers' objectives and so it will be in their interests to continue growing the trees. Having said this, there is a risk some of the parcels may not be full restored, either because farmer neglect the care of their trees or due to natural weather events such as hurricanes in the early years of the parcels. As a mitigation, Taking Root has conducted numerous capacity building and knowledge sharing workshops with Ecom to enable the long-term care of parcels for successful forest growth and carbon removal.
- **Future carbon reductions:** The project has begun trialling a potential solution to remove carbon by storing biochar in the soil, while reducing the amount of fertilizers used on coffee parcels, thereby leading to emissions reductions. As these trials mature it has the potential to create a solution which Ecom can apply across the thousands of coffee parcels it works with in Nicaragua
- **Taking Root solution scale up:** The project has enabled a solution to accelerate the restoration of the world's forests worldwide. Through this project, an indirect affect has been to enable Taking Root's impacts elsewhere in Nicaragua and worldwide by improving the service and technology it provides to local implementers to grow trees and create carbon financing from the carbon removed from the atmosphere. Since 2021, Taking Root has restored 8,000+ ha across Nicaragua outside of the project, generating +1.5 million anticipated carbon removals. As a result, the organization is also more financial stable and continuing to scale its work in Nicaragua and beyond, through establishing its business model in selling certified carbon removals from forest restoration.

5.6 Coherence

Throughout the course of this project there has been a large number of updates regarding climate related disclosures and claims.

- **Carbon offsetting:** Beyond this project, Taking Root will be focusing on developing projects which generate certified carbon offsets. This is to create a sustainable form of financing for projects moving forward. The certification Taking Root works with to create market-ready certified carbon credits is Plan Vivo. During the course of the project, Plan Vivo released its updated version 5 carbons standard. All the approaches built through this project are being aligned with v5 of the Plan Vivo standard so that trees which are grown in the future with Taking Root can be certified under v5 of the standard. This will provide companies like Arvid Nordquist access to high quality certified carbon removals in order to help meet climate targets.

- **Carbon insetting:** To measure progress and deliver on climate targets outside of offsetting, a number of accounting rules have been further developed during the course of the project, like the Science-based Targets Initiative (SBTi) and the Greenhouse Gas Protocol (GHG-P). While these initiatives have been around for several decades, clear guidance has been missing on how to set targets and account emissions land-use and agriculture (i.e. FLAG sector). For Arvid Nordquist – like any company in the food and agri-business sector – emissions from land-use and agriculture often represents a significant portion of the company's total carbon footprint but are notoriously difficult to measure and account for. To address this gap, SBTi and GHG Protocol have been leading two complementary initiatives:

SBTi Forestry, Land, and Agriculture (FLAG) Project	*GHG Protocol Land Sector and Removals Guidance*
• Guides companies on how to set specific for the portion of emissions related to the land sector. • Allows (biogenic) removals to be accounted for to meet FLAG targets, but only removals on working lands (as non-working lands are typically outside of a company's supply chain) • Participating companies are required to set zero deforestation targets. • Final guidance published September 2022	• Establishes accounting rules for emission reductions in corporate GHG inventories related to land management; land use change; CO_2 removals and storage (biogenic and technological); and biogenic products • Includes guidance on removals occurring in the company's value chain, i.e. insetting • Draft published in November 2022 and expected to be finalized by fall 2023

The emerging corporate requirements and accounting guidance coming out of these initiatives has had a trickledown effect on how Arvid Nordquist might think about its climate roadmap, targets and associated, investment options, accounting and monitoring needs, sourcing linkages, boundaries of interventions, etc. While it is still being finalized, particularly the fact that on-farm carbon removals can now count towards respective climate targets creates many opportunities for Arvid Nordquist to invest within its supply chain for future tree growing initiatives. This project has provided significant knowledge and capabilities for Ecom to support such projects if they are to be pursued by Arvid Nordquist.

6. INNOVATION

Through the project, there have been three areas of innovation developed:

1. A technology management platform for forest restoration
2. Knowledge sharing resources for successful forest restoration
3. A carbon calculator to help evaluate emissions reductions opportunities

Together, these help to effectively manage smallholder forest restoration projects at scale, and enable the reporting required to access carbon financing from forest restoration activities. The protocol and platform will remove barriers for farmers by taking away the need for expert-level knowledge and tools rarely available in smallholder contexts. This includes remote sensing, statistical analysis, machine learning, and modelling. The platform will also minimize the cost to project implementers of 1) collecting field measurements from thousands of farms spread across remote geographies and; 2) processing and reporting on that information.

A technology management platform for forest restoration with smallholder farmers at scale
Taking Root has further developed its software platform (previously called FARM-TRACE). The software platform is being designed to achieve two outcomes. First, to provide a management platform to enable project implementers to successfully plan, manage and track forest restoration work with smallholder farmers at scale. Second, to have Taking Root's protocol built in so that the platform generates all the reporting required for the generation of Plan Vivo certified carbon credits from forest restoration activities.

Through this project, the software received significant developments to integrate the protocol, including:

a) Parcel mapping

- Implemented new Quality Assurance and Control processes and weekly reporting to ensure correct parcel mapping. This includes implementing flags on any parcels mapped under <0.5 ha (which can often point to mapping errors) and flagging any new parcels which overlap with other mapped parcels so they can be remapped. (More information how Taking Root's platform facilitates accurate parcel mapping can be found here).

b) Forest monitoring

- Completed the rebuilding of the platform's carbon calculations to be more robust and traceable to be able to audit the platform's results against the protocol.
- Implemented new Quality Assurance and Control processes and regular reporting to ensure accurate field data collection entry. For example, checks in outliers for tree measurements.
- Built a new simplified monitoring interface so data collection in relation to tree counting and parcel baselining is simplified and quicker for project implementers. The interface was built by the end of the project and is currently in testing for release by July 2023.

c) Activity tracking

- Created the ability to upload and report on activities linked to farmers and parcels in order to track work performed on parcels being restored, and its progress against restoration targets.

d) Project management

- Released the ability for multiple technicians to gather data for one parcel and/or farmer. This has made it easier for local teams to facilitate and co-ordinate data collection from parcels/farmers.
- Enhanced the platform's performance and scalability by rewriting features into new technologies. This includes moving the platform to a number of Google Cloud services, resulting in a faster experience for users and the ability to manage greater datasets in order to manage forest restoration projects across hundreds and thousands of parcels in the platform.

Knowledge sharing for successful forest restoration with smallholder farmers
Alongside the development of Taking Root's protocol and software platform, the project has enabled the development of resources to support the adoption and implementation of Taking Root's protocol and platform. These resources are integral to facilitating knowledge sharing to enable project implementers to manage their forest restoration projects successfully and access carbon financing. Project resources created through project can be found in the supporting documents and cover topics below through a variety of mediums including one pagers, presentations and video;

1. How to map parcels using the mobile application
2. How to monitor parcels using the mobile application
3. How to assign technicians to farmers/parcels in the web application
4. The release of new feature and mobile application versions

Alongside these resources, the project has enabled the creation of a customer service function at Taking Root which facilitates training in line with these resources. It also acts as a point of contact for project implementers and users in the field to troubleshoot problems in a timely and responsive way to facilitate timely and accurate data collection and reporting.

The project has driven the development of Taking Root's management platform, reporting and knowledge sharing capacity. Together, they are creating an out of the box set of resources for smallholder groups around the world to successfully manage, report on, and finance forest restoration projects with smallholder farmers at scale through access to the carbon markets.

A carbon calculator to help evaluate emissions reductions opportunities

In addition to the innovations above, the project has created a carbon calculator to enable Ecom to measure and track emissions from on-farm activities. This will help enable the assessment and tracking of emissions and initiatives to reduce those emissions over time.

7. POTENTIAL FOR SCALING UP AND FOLLOW-UP INVESTMENTS

The most effective way for Taking Root to scale its work is through the development of certified carbon removals from growing trees with smallholder farmers. As such Taking Root is using the solutions created through this project to:

a) Expand its work restoring land in Nicaragua through the CommuniTree program
b) Develop projects in new geographic locations under v5 of the Plan Vivo Standard

Taking Root plans to fund this work through a combination of corporate financing and philanthropic funding. The core work to plant and grow trees will be funded through the sale of carbon removals to the corporate sector. However, further investments into building out its technology platform and building new projects will require philanthropic funding. An overview of the areas in which Taking Root is seeking additional philanthropic funding is here.

With regards to the intervention areas under the NCF project. Taking Root has passed all the data created from the project to project partners so that they can continue to monitor and track the effectiveness of project interventions. Further activities or scaleup would need to be established in line with corporate interest.

8. RISKS

Only one of the project risks in the table below materialized, indicating the efficacy of the mitigation measures outlined in the Project Description.

Project risk - description	Mitigation measures adopted
Adoption risk: The solution will only work if each player across the supply chain uses FARM-TRACE. In particular, we will need to ensure producer organizations which Arvid Nordquist source from collect data using the FARM-TRACE platform.	- Taking Root had already reached out to each producer organization to explain the benefits of FARM-TRACE prior to the project start - Taking Root designed a hands-on approach with in-person training to ensure producers and organizations involved got the most value possible from the solution - Taking Root created culturally appropriate training materials to support implementation
Political unrest: Nicaragua saw substantial political and civil unrest prior to the project start. There was risk that this could happen again, disrupting elements of the project.	The locations proposed for the project were in rural areas that were less affected.
Reporting accuracy risk across farms: having conducted the initial farm assessments and forest inventories, much of the reporting by FARM-TRACE will be done through machine learning assessments of satellite imagery. There is always a degree of inaccuracy with remote sensing so we will need to be sure to assess the accuracy levels of the reporting.	FARM-TRACE has already been used in the same ecoregion as the proposed project. for several years and so the machine learning algorithms had been previously trained. The FARM-TRACE team also has extensive experience of working with machine learning algorithms and so will be able to help hone the algorithms over time.
Materialized Risk	
Covid 19	Activities continue to be conducted in small numbers and outdoors. Where necessary Covid-19 protocols were followed such as social distancing and mask wearing. Each project partner was responsible for their organization following best practice Covid-19 guidelines for work related to this project.

9. MONITORING AND EVALUATION

Beyond Taking Root, the results have been monitored by Ecom to validate the results which have been generated. In addition, Rainforest Alliance were consulted in the creation of the carbon calculator to ensure it covers the information required by the Rainforest Alliance Standard.

10. LESSONS LEARNED

1. There are opportunities for carbon reduction and removals within Arvid Nordquist's supply chain

a. **Water and waste treatment emerged as the largest on-farm emission source based on results from the carbon calculator:** Accurate emissions estimates for different agricultural emissions sources are needed to develop options that reduce greenhouse gas emissions while improving smallholder farmers' livelihood. The carbon calculator developed through this project was applied to the farm-to-port footprint of 15 producers in the 2021 pilot program for coffee production. The carbon emission pools investigated included transport, water and waste treatment, energy use (non-transport), fertilizer and pesticides. The results reveal an average emission of 1,052tCO2e, approximately 1.01 kgCO2e per kilogram of coffee produced, or 10.4 tCO2e/ha for the pilot year. Notably, water and waste treatment emerged as the largest contributor to emissions (69%), followed by fertilizer and pesticide application (29%), with transportation (1.4%) and energy consumption (0.12%) constituting the remaining sources. Depending on which coffee farms supplied Arvid Nordquist for the year, these results can be used to connect to Arvid Nordquist's corporate climate footprint. Furthermore, to facilitate a deeper understanding and potential application of these findings, the project recommends fostering further knowledge exchange between U&We, Arvid Nordquist, and ECOM.

b. **Preliminary results from the biochar trials hold promise but require further research and analysis to determine whether to implement at scale:** There are opportunities to reduce fertilizer applications and add biochar as an alternative amendment to coffee farms. However, little research has been done to understand what the results would be of changing and reducing current input regimes. ECOM welcomed the opportunity to use this project as an opportunity to better understand and pilot different input regimes to inform future decisions about how they might be able to maintain or improve farmer yields while delivering CO2 reductions. The trials were conducted across 2.4ha spanning five parcels. By applying a 50% reduction in fertilizer and varying doses of biochar, the interventions achieved cost savings through reduced fertilizer application while observing notable differences in tree growth, vigor, and disease resistance across different treatment parcels. While the results of the pilot seem promising, ECOM would need to undertake further research and analysis and continue to monitor results to fully quantify the contributions of biochar application to productivity gains and emissions reductions before deciding whether to implement at scale.

c. **There is opportunity for growing trees and removing carbon on new areas of coffee production:** During the course of the project, it was found that many of the parcels Arvid Nordquist sources from already have a high level of forest cover/carbon baseslines. However, by driving new demand from new coffee agroforestry locations it could deliver carbon removals for Arvid Nordquist to meet insetting goals alongside its existing carbon offsetting strategies.

2. Coffee growers and potential buyers should align on environmental outcomes to design and report against future project interventions accordingly.

If value chain interventions are going to succeed in delivering value to coffee brands and achieving their desired climate impacts, improved monitoring and reporting is required. European directives 2005/29/EC and 2011/83/EU set out that to empower consumers in taking part in a green transition, corporate climate related claims must be supported by clear, objective and verifiable commitments and supported by an independent monitoring system to monitor the progress of the commitments and targets. For companies such as Arvid Nordquist this is less of a challenge for scope 1 and 2 emissions as it is for scope 3 emissions. For example, Arvid Nordquist has already taken extensive efforts to track and reduce its emissions from sources including its roastery, packaging and transportation. However, given its scope 3 emissions take place in different countries and often across hundreds of thousands of individual coffee growing parcels, tracking and implementing interventions represents a challenge.

There are two potential pathways corporates such as Arvid Nordquist can undertake to create the necessary supply chain reporting required to meet climate commitments in line with European policy directives;

a. Third party carbon certification: By utilising carbon standards such as Plan Vivo or Gold Standard, this would provide a framework for monitoring and reporting on carbon reductions and removals against climate commitments.

b. Supply chain accounting standards: Measuring, monitoring and reporting on interventions in line with standards including ISO 14067, GHG Protocol and SBTI FLAG would provide specific guidance and frameworks to follow in order to substantiate any claims against climate commitments.

Whichever route is taken by corporate actors such as Arvid Nordquist, there is need for improved data collection and reporting tools and systems which a) minimises the cost and knowledge required to generate reporting on source farms b) provides robust and simple reporting which can substantiate corporate reporting and claims. For any value chain interventions, it is important that buyers and associated value chain actors are aligned on the specific environmental outcomes sought to be achieved.

3. **Financial sustainability and scale potential means Taking Root is specializing in restoring forests by creating certified carbon removals with smallholders**

As an organization, Taking Root has learned through this project and other simultaneous pilot projects, the best way it can achieve its mission - enabling smallholder farmers to improve their livelihoods by growing trees - is to focus on developing certified afforestation/reforestation carbon projects. As such Taking Root are now focusing solely on Afforestation/Reforestation project types through end-to-end partnerships where Taking Root provides support and technology to co-design projects with local partners, implement operations and grow trees, issue certified credits, and sell those credits to our network of retail partners. Taking Root is already applying this approach on cacao and coffee landscapes in Dominican Republic, with the potential to restore 25,000 hectares of land and delivering 5 million carbon removals.

11. OUTREACH

The results have been communicated via milestone reporting throughout the project period. A final project meeting was scheduled to discuss project results, lessons learned, and recommendations and served as an opportunity to receive and address feedback from NCF.

Through a combination of events and direct conversations the project has already reached 20 organizations across the sector. This included Taking Root presenting on a panel at SCA 2021, as well as participation of Taking Root at the World Congress of Agroforestry and the Verge Conference 2022.

Other knowledge resources such as blogs and videos were created throughout the project to educate the industry on Taking Root's model. These can be found in the accompanying documents below.

The accompanying documents listed below can be found at the link.

1. Carbon Calculator results: **Calculator_Finalresults**
2. Carbon Calculator raw data from farms: **Calculator_Pilot_Raw_Data 230119**
3. Coffee Agroforestry research results: **Coffee_Agroforestry_Research_Results**
4. Data package: **NCF_Arvid_Ecom-2023-06-26-Data_Package**

Ability to extract data from the platform to deliver proof of impact has been created and can be found in the supporting data package. The contents of the data package include:

- Data Dictionary – to explain the contents of the data package.
- Documents CSV
- Farms CSV
- Points of Interest CSV
- Points CSV
- Producers CSV
- Technicians CSV
- Trees CSV
- Versions CSV
- Worklogs CSV

5. Forest Baseline Results: **NCF_Informe de linea base_Dec17_2021**
6. Intervention and Budget Update Letter: **ImpactatOrigin_InterventionBudgetApproval**
7. Project photos: **NCF_Arvid_Ecom_Photos**
8. Training Materials: **Training_ppts**
9. **Events**

In addition, the following blogs were released during the course of the project:

4. https://takingroot.org/how-do-farmers-benefit-from-growing-trees/
5. https://takingroot.org/why-forest-value-chains-create-higher-quality-carbon-credits/
6. https://takingroot.org/considerations-for-mapping-reforested-land-with-smallholder-farmers/
7. https://takingroot.org/equitable-benefit-sharing-understanding-forms-of-value-for-communities/
8. https://takingroot.org/the-importance-of-equity-for-successful-benefit-sharing-in-reforestation/

12. FINANCIAL SUMMARY

Table 1. Project financing per partner

Expenditures, EUR	NCF	Grantee	Total
Arvid Norquist	-	35 880	35 880
U&WE	8 489	16 644	25 133
APRODEIN	76 070	8 014	84 084
Farm-Trace	242 419	35 989	278 408
Rainforest Alliance	-	3,990	3,990
Total	326 977	100 518	427 495

13. CONCLUSIONS AND RECOMMENDATIONS

In summary, the project has delivered climate adaptation and mitigation activities with smallholder farmers which have been verified through Taking Root's software platform. The project has enabled significant investments into Taking Root's software platform and accompanying training materials in order to help smallholder farmers access the carbon market through forest restoration.

For Arvid Nordquist the next step is to assess carbon reduction and carbon removal possibilities within its supply chain, and how they support supply chain accounting standards. The learning from this project is that one project type doesn't fit all (regions) and the need of balancing the greatest reduction impact and greatest communication impact. To be successful the investments made in the supply chain need not only to reduce risk (or footprint) but also to create a stronger market position.

For Taking Root, it has already begun scaling its solution within Nicaragua and globally across commodities outside of coffee to deliver high quality carbon removals and restore forests. It is currently growing its CommuniTree program in Nicaragua and actively developing new projects including designing a forest carbon removal project to enable smallholder cacao farmers in the Dominican Republic to access the carbon market by growing trees.

Annex 1 Project completion fact sheet

Project Name:	Impact at origin: catalyzing sustainable agriculture with smallholder farmers − Nicaragua		
Project no.	NCF 9 Project No NCF-C9-1206		
Country:	Nicaragua	**Financing:**	
		EUR	**%**
Nordic Partner:	Arvid Nordquist	35 880	8%
Local Partner:	APRODEIN	8 014	2%
	FARM-TRACE	35 989	9%
	Rainforest Alliance	3 990	1%
Other Partner:	U&We	16 644	4%
	NCF grant disbursed	326 977	76%
	Total		**100%**
Classification:	Combination		
Project cycle:	Project start date: 01/03/2021 Closing date: 30/04/2023		
Short project description:	The Impact at Origin project is demonstrating a replicable solution for brands across the coffee sector to reduce their climate footprints by reforesting their own supply chains. If the coffee sector adopts more forest friendly farming practices it could remove up to 148 million tons of carbon from the earth's atmosphere. Coffee brands are committing to reforesting their supply chains offering the opportunity to mitigate climate change and create a new revenue stream for farmers. However, brands currently lack the proof of impact they need to make reforestation investments effectively to meet their commitments. Current reporting solutions are prohibitively expensive as coffee production is highly fragmented and distributed across farms while needing scarce expertise to deliver the rigour needed to report against complex impacts. Leading Swedish coffee roaster, Arvid Nordquist, are implementing FARM-TRACE to automate the		

	measurement, verification and delivery of reforestation impacts with coffee farmers across their Nicaragua coffee supply chain. FARM-TRACE is a cutting-edge technology platform which automates forest and carbon assessments on smallholder farms by combining mobile, satellite and machine learning data. Using FARM-TRACE and supported by local partner APRODEIN, sustainability consultants U&We and Rainforest Alliance, the project implemented and verified reforestation impacts with coffee farmers across more than 1,400 hectares of land in the region of Matagalpa. The result is a solution for Arvid Nordquist and the whole coffee sector to invest in reforestation with coffee farmers to meet their climate commitments while unlocking revenue opportunities for farmers growing trees and delivering largescale emissions removals.		
Project performance:	**Expected Outcomes and Outputs**	**Achieved**	**End-of-project status**
	Outcome: 18,000 tCO2 to be sequestered from the atmosphere over time.	19,541tCO2	Completed
	Output: 1,400 ha of land within Arvid Nordquist's coffee supply chain mapped.	1,527 ha	Completed
	Output: Arvid Nordquist have forest carbon and fertilizer emissions reporting across 1,400 ha of mapped farms	100%	Completed
	Output: Arvid Nordquist ensures the $4m it currently spends on its Nicaragua coffee supply chain only supports zero deforestation farms	NA	Not completed
	Output: Implement climate smart farming practices to increase forest cover and reduce fertlizer emissions on 90ha of Arvid Nordquist's source coffee farms	107.5 ha	Completed
	Outcome: Total of 700 farmers engaged in the project	365	Completed
	Outcome: Increased Income for Producers of 1.1 million euros	NA	Not completed
	Output: 2 organizations trained to support producers adopt long term climate adaptation techniques	1	Completed
	Output Improved producer sales and investment from sustainable production by 100,000 Euros	53,538 Euros	Completed
	Output: Reduced fertilizer usage through optimised applications	50% on 2.4ha	Completed
	Output: Cost savings through program efficiency gains and automated reporting	NA	Not Completed

Climate change outcomes and impacts:	**Mitigation outcomes** Based on 107 hectares of land being restored, with 316,253 trees planted it is estimated that around 19,541 tCO2 could be sequestered if those trees mature into forests. This is based on an estimate of around 150tCO2 being sequestered per hectare over the next 20 years and excludes carbon sequestered through biochar applications on parcels or through any other potential emissions reductions in future years resulting from the project. **Adaptation outcomes:** From an adaption perspective, Nicaragua's coffee is grown by 44,000 farmers, employing 15% of the labour market[11]. However, it is extremely susceptible to climate change with 90% of Nicaragua's coffee growing areas predicted to be negatively affected by 2050 due to rising temperatures[12]. While further analysis would need to be undertaken to quantify the benefits of reforestation, literature suggests that increasing forest cover on farms can decrease on-farm temperatures from 2-6°C[13] improving agricultural resilience to warming temperature and preventing large yield declines.
Development outcomes and impacts:	- **Improved farmer livelihoods:** The project restored 88.41 of new coffee agroforestry by planting shade trees alongside coffee trees. These new coffee agroforestry plantations will help coffee producers unlock new coffee harvests worth over +$50,000 annually. This will bring increased financial resilience and improved livelihoods to the farmers involved in the project. - **Local economic development:** The project has supported the creation of 6 full time local roles which will be continued beyond the project. These roles are all focused on sustainable land-use practices and digital monitoring, reporting and evaluation. - **Increased farmer climate resilience:** 107.5 ha of land was restored through the planting of coffee agroforestry and shade trees across coffee landscapes. 25 farmers and their families (around 75 people) now have improved climate resilience for coffee production in the context of rising temperatures and more volatile weather due to climate change. - **Created tools to drive gender equity:** The project has generated a dataset to provide transparency into gender equality across coffee producers. By developing and leveraging traceable and transparent

[11] https://apps.fas.usda.gov/newgainapi/api/report/downloadreportbyfilename?filename=Coffee%20Annual_Managua_Nicaragua_6-13-2017.pdf
[12] https://link.springer.com/article/10.1007/s10584-016-1788-9?dom=icopyright&src=syn
[13] https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0006487

datasets through digitizing farmer, parcel and impact data, the project has the potential to improve yields for participating farmers by targeting customized interventions and support from farm co-operatives, Arvid Nordquist, and local financial institutions. Additionally, gender disaggregated data across 1440 hectares of coffee farmland can also be used to promote equality by identifying gaps and bridging these using equitable payments and services. In addition, in a country where male land ownership is typical, the project's beneficiaries were made up of 25% women.

- **Built local capacity and knowledge sharing with local teams**: Throughout the project, there was ongoing knowledge sharing in best practice agroforestry and monitoring and reporting to achieve sustainability outcomes. This was achieved through formal workshops and meetings as well as ongoing working collaboration.

NCF core indicators

NCF core indicator	Progress during this milestone (number)		Cumulative progress (number)		Clarifications/Means of verification
Number of beneficiaries reached	Women	6	Women	6	Taking Root web application (previously Farm-Trace).
	Men	23	Men	23	
	Unspecified	336	Unspecified	336	
	total	365	total	365	
Number of people with increased resilience to climate change	Women	6	Women	6	Taking Root web application (previously Farm-Trace).
	Men	23	Men	23	
	Unspecified	336	Unspecified	336	
	total	365	total	365	
	Women	6	Women	6	

	Number of people with improved livelihoods	Men		23	Men		23	Taking Root web application (previously Farm-Trace).
		Unspecified		336	Unspecified		336	
		total		365	total		365	
	New decent jobs created	full-time	women	4	full-time	women	4	• Ecom staff working on the project • Taking Root staff working on the project • APRODEIN staff working on the project
			men	9		men	9	
			total	13		total	13	
		part-time	women	0	part-time	women	0	
			men	0		men	0	
			total	0		total	0	
		seasonal	women	0	seasonal	women	0	
			men	0		men	0	
			total	0		total	0	

Annex 2 Results Framework

See section 2. Achievement of Results for detailed Results Framework.

Annex 3 Pictures

Image 1: Technician confirming correct location of monitoring point within the parcel using the Taking Root application.

Image 2: Project technician measuring the DBH of a tree as part of the baseline monitoring done in coffee farms that are part of Arvid Nordquist supply chain.

Image 3: Producer Juan Jose Cruz Zeledon harvesting coffee from an agroforestry system which is part of the project.

Image 4: Nearby general landscape in Nicaragua from which the carbon baseline was calculated.

More photos from the project are available here.

Annex 4 Other supplementary deliverables/documentation/links

See section 10. Outreach.

Annex 5 Impact story

The world is losing its forests because people see more opportunity in cutting down trees than growing them. The land stewarded by smallholder farmers collectively represents one of the biggest opportunities to restore the world's forests. However, farmers often face barriers to making land-use choices in favour of growing trees. Corporate actors such as coffee brands who want to meet climate targets could represent a solution. In the coffee sector alone, actors have pledged to reduce and remove at least 1.5 gigatonnes of carbon by 2050[14]. Corporate actors investing in meeting these climate commitments could provide a pathway to finance and incentivise smallholder farmers to improve their livelihoods by growing trees while contributing to climate solutions.

However, for smallholder farming groups, access to financing from corporates seeking to meet their climate commitments is often out of reach. It is too costly and complex to successfully manage and report on forest restoration activities and their impacts across fragmented smallholder landscapes to the level required for corporate actors to invest. The Catalyzing Sustainable Agriculture with Smallholder Farmers project set out to create a replicable solution for coffee brands to invest in climate impacts with smallholder coffee farmers. This would connect coffee brands with investible and verified forest and climate impacts would improve and build resilience for millions of farmers' livelihoods while mitigating climate change and helping companies deliver on their climate targets.

By using Taking Root's technology (formerly FARM-TRACE) to create verified farm-level impact reporting, the Catalyzing Sustainable Agriculture with Smallholder Farmers project, in collaboration with sustainability consultant U&WE and implemented by local partner, APRODEIN, has achieved the following:

- Successfully mapped 1,420 hectares of coffee farmland within the Arvid Nordquist supply chain, along with an additional 107 hectares where climate-smart project interventions were introduced. This data enables Arvid Nordquist to establish traceability and transparency, facilitating the tracking and verification of impacts over time.
- Generated baseline forest inventories across 1,420 hectares using inventory data collected by ECOM and APRODIEN. This dataset can be used to track the impact of interventions over time.

[14] BusinessGreen; Global coffee players brew up 2050 climate plan to slash 1.5 gigatonnes of CO2

- Implemented climate-smart farming practices across 107 hectares, including the planting a total of 316,253 (21,494 shade and 294,759 coffee) trees across 60 parcels. If these forests mature they could deliver 19,5410 tCO2 carbon removals once the trees mature into forests.

Image 1: Technician confirming correct location of monitoring point within the parcel using the Taking Root application.