

FINAL TECHNICAL REPORT / RAPPORT TECHNIQUE FINAL CLARE - ECOLIMITS BUILDING ECOSYSTEM SERVICES FOR POVERTY ALLEVIATION

Mason, John;Norris, Ken;

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CLARE - ECOLIMITS Building Ecosystem Services for Poverty Alleviation

IDRC Project Number-Component Number: 109238-003

Final Technical Report

By: *John Mason and Professor Ken Norris*

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Table of Contents

Project Outcome	2
Project Results	2
Project Implementation	3
Uptake.....	10
Additional Insights	11
Annex: Project outputs	13

Project Outcome

The outcome sought under the CLARE program is:

“Actors in planning, programme implementation, policy and research use a range of evidence-based options to enhance and support communities’ livelihoods in the face of climate challenges in ways that benefit the most vulnerable women and men.”

- *In general, how did this project contribute to that outcome?*
- *Recount a “story of change” from your project towards this outcome: a narrative that illustrates a change that can be attributed, in full or in part, to the project, supported by evidence from which we can demonstrate a plausible contribution. A story should mention the situation before the project, the intervention conducted through the project, and the change that occurred.*

Cocoa is Ghana’s largest agricultural commodity and the source of livelihood for hundreds of thousands of generally poor rural farmers. Despite its importance, prior to this project there had been no government led efforts to understand the relationship between cocoa production and climate change / climate shocks, and little appetite on the part of the Ghana Cocoa Board to share national cocoa production data in support of such analysis and planning. Therefore, Ghana’s ability to plan for and implement appropriate adaptation measures (based on a much deeper understanding of historical changes) that will support the broad sustainability of the sector and cocoa farmers’ livelihoods more specifically is very weak.

Despite numerous limitations posed by the Coronavirus pandemic, the CLARE—Ecolimits project team has, for the first time, gained access to the Cocoa Board’s long-term big data sets (over seventy years of production data at multiple scales) and successfully engaged the government in the analysis and review process. While often taken for granted, gaining access to long-term production data is one of the biggest challenges to climate change adaptation policy planning, which ultimately has a profound impact on the men and women who farm cocoa and are most vulnerable to the changing climate and periodic climate shocks. It is clear that the government and the private cocoa sector have realized the importance and value of such analysis.

Project Results

- *Complete the Annex identifying specific outputs generated under the project (knowledge products, engagement, and capacity strengthening)*
- *What were the most important results or consequences¹ arising from the project outputs and activities?*
 - *Why do these results matter?*
 - *How did the project advance knowledge and practice on climate adaptation?*

¹ Project outcomes include changes in behaviours, attitudes, practices, capacities, policies, relationships, technologies, etc. that contribute to climate resilience. They may result from the research process or the application of research findings. Consider the consequences (outcomes) that result from tangible achievements (outputs).

- *Compare intended and actual results - please comment on key results that were intended but not realized, and any unintended results that were realized.*

The most important results from the Ecolimits-CLARE project have been the following:

1. Gaining access to big cocoa production data and associated support from Cocoa Board in sharing data and review/revision. This outcome represents a significant change in behaviour and occurred because we worked with Cocoa Board to help them understand the value of analysing their long-term data.
2. Analysis by the project of socio-ecological data to understand relationship between climate, production and poverty. This work improved the capacity of key stakeholders to understand the inter-relationships between the environment (climate), farming and people's lives and livelihoods. We see this as an important step towards genuinely integrated policy that addresses the whole system rather than just parts of it.
3. Sharing results with a broad range of stakeholders (gov, private sector, research, civil society) to influence policy/practice, gain feedback, and generate recommendations for future research. This work had two broad outcomes. First, it has helped developed relationships between key stakeholder groups and individuals. Second, it has brought people together to co-design work that addresses knowledge gaps, and in this way ensure that future research really does address the issues stakeholders need to address.
4. Completion of the CoPod-Ecolimits Cocoa farmer smartphone application. This work significantly improved the capacity of farmers to understand their farming system and make informed decisions about its management.

We do not really see any clear examples of significant departures in our work between intended and actual results. While our big data analyses did reveal unexpected patterns of cocoa production in relation to climate shocks such as a spike in cocoa productivity the year after an El Nino event in recent decades, we see such insights as a normal part of the research process. Beyond this, project activities progressed broadly as we anticipated albeit with modifications due to coronavirus restrictions.

Project Implementation

- *Project management:*
 - *Briefly describe the activities supported under the project, including the research methods, instruments² and analysis used.*
 - *What were risks that were managed, or challenges faced, over the course of the project? How did the project team respond to these?*
 - *Restate the specific objectives of the project from the grant agreement. To what extent were each of these met?*

Our primary project objective was to scale up the results of the ECOLIMITS project by building a platform for future research and an associated research agenda, augmenting existing data and analyses, and deepening our ongoing engagement activities. Specifically, this entailed the following:

1. Cultivating in-country, interdisciplinary partnerships and long-term field sites.

² Add as an annex any questionnaires, interview guides, and other documentation useful to understanding the project

2. Collating and analysing long-term datasets on land-cover, climate, cocoa productivity and local livelihoods.
3. Developing, with in-country partners, a set of research priorities and questions addressing future climate resilience in Ghana's forest-agriculture landscapes.
4. Continue engaging with current policy processes to further understand governance dynamics and support the uptake of our existing results into policy and practice.

Our specific project objective activities were all successfully completed as follows:

Objective 1: Cultivating in-country, interdisciplinary partnerships and long-term field sites

We successfully completed this objective following the selection and assessment of long-term field sites for geographic scaling of the project. The site assessment report was submitted to IDRC as part of the previous reports.

The project secured, equipped and staffed a field office in the Bia long-term expansion landscape at New Debiso in Western North Region. We engaged extensively in the project expansion landscape to understand local indigenous context, key stakeholders and relevant sector initiatives in the area.

We consolidated our in-country partnerships including with the Forestry Commission, Cocoa Board, Forestry Research Institute of Ghana, Environment Protection Agency, relevant District Assemblies and Tropenbos Ghana. We also entered into cocoa sector specific collaborations with Lindt & Sprungli GmbH, Hershey Chocolate GmbH, Ferrero and Rocher GmbH, Olam Cocoa Ghana, Ecom Trading Ltd., Lindt Cocoa Foundation, Touton GmbH, and World Bank Ghana Mission/Forest Carbon Partnership Facility.

Our UK team also initiated a partnership with the UK Centre for Ecology and Hydrology (UKCEH) (led by Dr. Lindsay F. Banin) and the University of Dundee (project led by Dr. Alexandra Morel who is a researcher in the ECOLIMITS-CLARE project) for "Co-Pod: A co-produced application platform to link people and practice to promote resilience in cocoa agroforestry in West Africa"

The aim of Co-Pod is to develop a novel farm management and information sharing tool to enable farmers to gain knowledge through more systematic observations on-farm, share learning with other farmers and catalyse locally generated adaptive management. The co-production of the app with in-country partners and local communities is a key feature, ensuring it is fit for purpose and meets the needs and aspirations of end users. This app will be open source guaranteeing that the work will bring maximum benefit to Ghanaian cocoa farmers and other organisations and countries involved within the cocoa supply chain and ensuring an un-impinged route to social and economic benefits.

The concept for Co-Pod evolved from the research experience and results of ECOLIMITS research and the evident need to address the on-going challenge of poverty in smallholder cocoa producer communities, which is partially due to Ghanaian cocoa farmers' low productivity, lack of training opportunities, and limited access to farming. In order to help address this, Co-Pod scoped the potential for a novel mobile application platform to assist farmers in accruing information over time to improve system understanding, the risk and reward of certain interventions and to promote resilience. The ultimate goal is therefore to co-develop sustainable agroforestry practices which deliver secured income and poverty alleviation.

We have been able to use the ECOLIMITS platform and project sites to conduct community-based workshops to define the challenges and data/information priorities of cocoa farmers. This information was used to develop the first phase of the Co-Pod app with farmer led testing completed in Nov. 2021.

This collaboration has provided financial resources of £127K project through a grant from Biotechnology & Biological Sciences Research Council (UKRI BBSRC) Global Challenges Research Fund (GCRF) African Agri-tech Catalyst Seeding Fund, with additional funding from the Scottish Funding Council (SFC) Global Challenges Research Fund (GCRF).

Objective 2: Collating and analysing long-term datasets on land-cover, climate, cocoa productivity and local livelihoods

We completed this objective successfully. The project used its wide network, in-country and internationally, to gain access to a broad set of existing data sets of importance to the project including forest data, meteorological data, and cocoa production data sets. These data sets have been secured from government, research institutes and private sector sources in examples of rare collaboration in big data sharing. All of the data sets have been collated and uploaded to a common Microsoft Sharepoint platform managed from NHM partner in the UK. We gained access to more granular breakdown of historical cocoa data covering the past 70 years of Ghana production.

The project post-doc based at NHM undertook analysis of these data sets towards developing a detailed understanding of the historical patterns of Cocoa Production in relation to climate shocks, specifically those that arise due to El Nino events. In the tropics, El Nino brings hot, dry weather that can cause widespread damage to crops and livelihoods. The frequency and magnitude of El Nino events are increasing under anthropogenic climate change, yet the impact of these events on Cocoa are not well understood. This analysis seeks to explore how cocoa production responds to El Nino events, and how this response may have changed over time. The analysis also examines the impacts of El Nino on the climate of Ghana, in order to identify the climatic teleconnection that might proximally drive cocoa production variation. This work is based upon three datasets: (i) records of the Oceanic Nino Index since 1950, used to identify El Nino/La Nina, (ii) data from the ERA5 climate dataset for the cocoa producing areas of Ghana since 1950, and (iii) cocoa production data for the 6 cocoa production regions for the period 1947-2018 and for 66 cocoa production districts for the period 1998-2018.

The climate data comprised temperature, precipitation, solar radiation and windspeed data, and these were used to calculate several meaningful water deficit (drought) indices relevant to crop productivity, namely Vapour Pressure Deficit (VPD), Cumulative Water Deficit (CWD) and Potential Evapotranspiration (PET). These indices, alongside temperature and precipitation, were summarised over time and used to compute climate anomalies based on the reference period 1981-2010. Cocoa production data was also z-score detrended to remove the effect of varying area under production over time and between districts/regions.

Our results from these analyses show clear responses in climate and cocoa production to El Nino/La Nina events, and these responses have changed over time. In district-level data, covering the last 20 years, cocoa production is significantly lower than average the year of an El Nino event, although the following year sees a significant mild increase in production. However, the region-level data, covering the last 70 years, show that this response to El Nino has arisen over the last 20-40 years; prior to the

1980s, the response was reversed, with a weak improvement in production compared with average the year of an El Nino, and a weak reduction the year after.

These production responses to El Nino are likely driven by climate. In the year of an El Nino event, Ghana's cocoa producing region has significantly higher temperatures and lower rainfall, particularly in the major wet season. These combine to generate significant drought conditions for Cocoa, as measured by all three drought indices. Over the 70 years studied, mean temperature in all seasons have significantly increased and rainfall in the major wet and dry seasons have substantially decreased, with concomitant impacts on drought. The impact of El Nino on climate has also shifted over time, with the impact on rainfall in the major wet and dry seasons decreasing slightly, but more strongly affecting temperature in the major dry season than in the past.

These shifts in the El Nino climate regimes over the last 70 years is likely to be the major driver of cocoa responses to El Nino. Clearly, Cocoa is vulnerable to shocks in the climate system, creating short-term volatility in crop productivity that may have serious impacts on the livelihoods of Cocoa farmers. Unfortunately, these results suggest that this volatility has increased over time, driven by changes in climate, and that further climate change will drive more frequent El Ninos with greater impacts on Cocoa production. Findings from this analysis generated attention and interest from in-country stakeholders – particularly the Cocoa Board and private cocoa companies. This was able to be fed into Objective 3 and 4 activities below. A peer review paper was prepared from the data analysis which is now in submission for publication.

Objective 3: Developing, with in-country partners, a set of research priorities and questions addressing future climate resilience in Ghana's forest-agriculture landscapes

The activities under this objective were envisaged as part of UK and Ghana inter-disciplinary set of engagements over the project period. Covid-19 restrictions have meant that the UK team members were not able to travel to Ghana. Rather we had to adapt and the NCRC team led the implementation of Objective 3 activities in the fall of 2021 with virtual participation of the key members of the UK team. While the pandemic forced us to change aspects of our approach and methodologies, we have been able to complete all envisaged activities outlined in our plan. The delay in undertaking this objective allowed us to incorporate the data analysis resulting from Objective 2 above into the inputs for Objective 3 engagements. This resulted in a high level of engagement by the wide group of stakeholders who were very keen to learn directly from the project team on the findings.

The project engaged four distinct stakeholder groups in a series of consultative meetings at national, regional and rural levels. The stakeholder groups were as follows:

- Non-government organisations (NGOs) and research institutions
- Government institutions
- Private sector cocoa and chocolate companies
- District level partners and rural landscape level leaders in both CLARE project sites.

The aim of these consultative meetings was to present the results from the project data analysis, to gather feedback and reactions from stakeholders to the findings, and then receive input and guidance

on future cocoa-climate research priorities. The meetings discussed cocoa climate related issues including:

- Discussions about the relationship between and effects of climate shocks on and cocoa production, namely El Nino Southern Oscillation (ENSO) events, which brings about either hot and dry weather (called El Nino) or cooler and wetter weather (La Nina).
- El Nino events cause an immediate 20% decline in cocoa production off the non-El Nino trajectory, and then in the following two years production rebounds. Conversely, La Nina tends to cause an up-swing in national production. 2021, being the highest ever national production, was also a La Nina year.
- This pattern however, only emerged in the late 80s and early 90s. Prior to 1987, the ENSO impact was the opposite of what is documented in recent years. This suggests that cocoa production is changing in response to a changing climate and conditions, and could very likely change again in the future.
- Socio-economic household of cocoa farmers from Kakum site also explored the effects on farm yields and farmers' responses to climate change. The majority said they had experienced a 50% decrease in cocoa yields due to climate change and some said they had near total failures. Regarding the effects on farmer's livelihoods, some said they had to borrow money to buy food, send their wards to school, or for healthcare. With respect to resilience and strategies to avoid future negative impacts, it was interesting that in Kakum (not Bia) about 50% of farmers said that they had never seen/worked with a cocoa extension officer service, nor received any agricultural extension service.

Objective 4: Continue engaging with current policy processes to further understand governance dynamics and support the uptake of our existing results into policy and practice.

The project engaged on four different aspects of policy and practice in the project sites:

- Cocoa crop forecasting using big data and its implications,
- Community/landscape level safeguards in light of climate impacts for cocoa farmers;
- Child labour issues within the cocoa sector and if there are climate linkages;
- Fair approaches to handling cocoa farms illegally sited inside reserved lands (national parks and forest reserves of high forest zone) of which cocoa produced from such farms will soon be banned from export to a growing number of countries.

The cocoa forecasting implications emerged from our data analysis in Objective 2 above has stimulated vigorous discussions among stakeholders with regard crop forecasting in light of decadal plus data sets, farm gate price setting with implications for farmer income, negotiations with crop buying companies and geographic focusing of specific cocoa sector interventions. The Cocoa Board and the private sector is particularly keen on the strength of such analysis and how it can support their work with farmers.

Our meetings with the Cocoa Board have had very high-level audience, including the Deputy Chief Executive Officer for Operations, the Deputy Director of Research, Monitoring & Evaluation (RME), a

number of senior staff at RME, the Cocoa Health and Extension Division (CHED) who are extremely influential, and another group of mid-level officers. This was the most positive and responsive meeting NCRC has had with Cocobod in the past decade. Receiving their audience is one thing, but the evident interest and engagement on the topic was quite outstanding. Most of the people also remembered our earlier work under Ecolimits in a very positive light.

There were three clear reasons for their interest, the first being how it can help Cocobod and specifically the Deputy CEO with forecasting and managing their cocoa bean stocks in uncertain times. The second was the need to understand how El Nino events may impact production and recommendations that one might make to enable farmers to 'weather' such events. The third was a strong interest in better understanding the analysis and making contributions so as to be able to finalize it and have a result that they fully understand and feel they can stand behind.

From the scientific standpoint, the Cocoa Board interest in forecasting and stock-management may not be high, but in terms of how this work can have a very practical and hugely important impact on the sector, is likely the most important outcome. Climate change, climate shocks like El Nino, and economic/market fluctuations are creating huge challenges for Cocoa Board.

The project was invited to participate in a series of Safeguard and Grievance policy meetings with communities in the two CLARE Ecolimits sites. These meetings were led by the government Forestry Commission and the project was able to provide practical input to finetuning the policy. This process is ongoing and offers valuable opportunities to engage and support these processes.

The project was challenged by government and private sector to take the lead in facilitating site level discussions on the issue of child labour in cocoa farms and how to handle fair settlement of cocoa farms which are located inside gazetted forest reserves and wildlife reserves/national parks. We began low level dialogues with farmers and indigenous leaders about this issue to gather insights from the farmer and community perspective to prepare initial input to broader discussions for a policy/practice pathway to a long-term solution for this challenge.

NCRC has strong relationships with key government bodies relevant to this project: Forestry Commission and Cocoa Board. These relationships go back over decades and as such NCRC is approached by these institutions to help figure out challenging issues which are difficult for the agency to lead because every step may be precedent setting in their system. Further these are issues which the private sector is extremely concerned about as it will affect market access in the near future but which they are entirely ill-equipped to address.

As such NCRC has been asked to explore and facilitate a pathway for handling illegal cocoa farms inside forest reserves and national parks and advising on child labour issues. These are very contentious challenges and government's previous efforts have involved law enforcement and have failed miserably. Now both Forestry Commission and Cocoa Board have accepted that a new approach involving negotiations and incentives that respect human rights are required. NCRC explored ground up farmer and traditional leader perspectives about how to move these issues forward. As mentioned, this is an extremely sensitive issue and NCRC's neutrality and pioneering record has positioned us to support finding solutions with farmers, traditional rulers and government involvement. We prepared an initial report on the child labour issue in the project sites but are yet to prepare any written output on illegal farms.

Risks Encountered

The project faced two key risks: possible refusal of access to big data held by government and private sector and covid 19 pandemic impacts on successful completion of the project work plan.

Access to big data: we had made a courageous assumption that using our established cocoa sector networks the project would be able to gain access to highly restricted historic big datasets on cocoa production from the Ghana Cocoa Board and private sector sources. We knew this was a risk but our assumption proved largely correct as our long-standing relationships proved fruitful and we gained access to 70 years of cocoa production data at national, regional and district levels. This access was previously unheard of and we acknowledge the Ghana Cocoa Board in particular for their confidence in our careful use of their data sets.

Covid 19 pandemic: we had not imagined that a global pandemic would sweep the globe paralyzing movements and interactions between locations and people ranging from the very local to international levels. We had not expected this risk and had no plan to deal with it. We had to re-think and adapt our approaches to avoid utter failure of the project. We increased the level of in-country implementation responsibility. We altered the order of planned implementation schedule to allow the various objectives activities to proceed in a staggered manner rather than moving forward simultaneously. We made full use of virtual methods of engagement with UK colleagues making presentations and engaging with stakeholders using internet platforms. In the end our adaptations worked well and produced solid results including a deeper level of stakeholder engagement than we would have probably achieved under our original plan.

Challenges Overcome

In 2020 our project was disrupted due to Covid-19 restrictions thus we restructured our project plan to expand activities from January 2021. The Covid situation has been less of an impact for the team within Ghana than for the UK team. In fact, the Ghana team has been able to work very effectively in the later part of 2020 and throughout 2021 until advent of Omicron variant imposed increased risks in November and December 2021. This resulted in the UK team being unable to travel to Ghana throughout the project period. As a result, we further adjusted our plans to enable NCRC team to implement the Objective 3 activities in the fall of 2021 with virtual participation of the key members of the UK team. While the pandemic forced us to change aspects of our approach and methodologies, we have been able to complete all envisaged activities outlined in our plan.

- Gender and social inclusion: Briefly describe how the project supported such through team composition, research methods & process, and project results.
 - Identify the steps taken to prevent harm from occurring (safeguarding³), along with any lessons learned in this regard.

Gender and Equity

³ Safeguarding is preventing and addressing any sexual exploitation, abuse and harassment of research participants, communities and research staff, plus any broader forms of violence, exploitation and abuse relevant to research such as bullying, psychological abuse and/or physical violence.

Gender and equity have been key elements of our processes, which were used by the UK project team to recruit to the PDRA position and for NCRC to recruit additional field team members. NCRC's hiring and employment practices intentionally seek out and hire female staff and consultants in an effort to ensure solid gender representation within our work. While this can be a challenge given that natural resource management is typically a male dominated sector in Ghana, we were able to recruit two staff members in the field team were women with cocoa and forestry experience including a MSc holder from Wageningen University in the Netherlands. We further engaged a local young professional female Ghana/Zimbabwe national with an MPhil from Imperial College London as a consultant on aspects of the project.

In our community engagement and research practices, NCRC also intentionally integrates methods that focus on and give voice to gender and minority group representation. These methods include female-only focus groups, selection of female field/research assistants from the communities, attention to women's issues and experiences in our socio-cultural surveys and data collection and targets significant female representation in workshops and meetings. One of the climate resilient elements we have been working on including income diversification strategies focused on forest botanicals in which women are the majority financial beneficiaries.

Further in this regard, our Kakum project site has played a significant role in strengthening the power and voice of a suppressed minority indigenous ethnicity who pre-date the dominant ruling ethnicity. This has played out in high level of minority representation in the governance bodies of the climate-smart landscape management institutions.

Safeguarding

Our project sites are located within the broader scope of Ghana's Emission's Reduction Program with the World Bank FCPF Carbon Fund--the Ghana Cocoa Forest REDD+ Programme (GCFRP). NCRC has been a partner to the Government of Ghana in the conceptualization and implementation of this program including at our project sites. The GCFRP has a well-developed safeguards system in place with a strong focus on protecting the rights of local and marginalized people and it has launched a Safeguards Information System that will be used to monitor social and environmental safeguards, which meet both World Bank Safeguards requirements and those of the UNFCCC Cancun Agreement on safeguards. The GCFRP has designed and begun implementation of a Grievance Redress System in these areas, so our project has sought to ensure full compliance with this safeguards system. The project participated in a series of government led meetings in the project sites and provided practical input in this regard.

Furthermore, NCRC has a no-tolerance policy with regards to sexual exploitation, abuse and harassment. Within our institution and in our engagements with local people and communities in the landscapes where we work there is no tolerance for this type of behavior or interactions, as it is not only an abuse of people's rights but it undermines our core mission and purpose. Should any observation or reports arise, directors investigate and/or address the situation in compliance with GCFRP Safeguard procedures and national laws, and prioritizing protection of the rights of victims as the top priority.

Uptake

- *Describe project efforts, challenges and successes on supporting uptake⁴ of research results.*

⁴ Research uptake refers to efforts and outcomes in increasing the reach and use of research, such as in policymaking processes

- *Recount specific examples of:*
 - *Demand “requests by stakeholders and target actor groups to brief on, produce, partner in, or provide technical assistance to apply evidence, outputs, recommendations or follow-on projects based on the work conducted by your project”*
 - *Endorsement “indication of a binding use (formally or officially communicated by users, for example in office orders, meeting minutes or official messages that have been formally documented and announced) of any products, recommendations or communications from the project research”*

We have already realized that the data analysis findings from Objective 2 have generated significant interest in the cocoa sector in Ghana. We have held informal and formal dialogues on these findings with our partners and have received very high level of access to big data sets and clarity on questions that have been generated by the analysis. It is clear that a key issue is scale. Climate change represents a directional change in the climate over time. It includes gradual changes in climate over time but also changes in the frequency and severity of climate shocks. Understanding the impacts of these changes on biodiversity, ecosystems and people requires long-term data spanning contrasting climatic conditions. Furthermore, climate change is spatially variable as is the wider environment and the lives and livelihoods of people. This means the impacts of climate change are themselves likely to be spatially variable.

The project has been able to partner with Co-Pod in the development of the cocoa farming app for use with smart phones in the field. We noted in the IDRC-led learning review that at least one or two other projects had also sought similar paths to move work forward in these pandemic times. It was encouraging to learn that others had similar thinking and success in their ventures.

Our facilitation of how the cocoa sector can approach the illegal farms issue is still early but it is clear that the private cocoa sector and the government are looking at our project to provide neutral, respected advice and counsel. This issue will take much longer than this current funding but deserves the time and effort to ensure successful examples are concluded for adaptation and replication across the cocoa growing areas of West Africa.

Additional Insights

- *What lies ahead for your team in terms of future research directions and collaboration? If relevant, mention additional activities or research questions that emerged from this project.*
- *Provide any feedback to IDRC and FCDO as research funders:*
 - *Candid observations about the overall experience with the project are encouraged.⁵*
 - *We welcome recommendations and advice on future research needs or opportunities.*
- *How can we reduce the environmental and climate impacts of research activities in future project design and implementation? (optional)*

What lies ahead for Ecolimits? The strength of Ecolimits is that it represents a genuine collaboration among equals. Every participating organisation and individual involved brings a unique set of skills, knowledge and experience to the table. This has enabled us to approach research and research impact

⁵ Any sensitive or confidential information should be addressed through a direct exchange with the program officer, and documented and filed separately.

flexibly with the lead individuals and organisation dictated by the needs of each specific activity. A key component of this has been the strong in-country partnerships started under our ESPA funding and expanded during the current CLARE project. The importance of having NCRC as a strong and dynamic in-country partner with well established pre-existing relationships with key agencies and institutions has been critically important during the pandemic and we noted that this was an insight that multiple countries identified in the learning review organized by IDRC last year. Our CLARE project would have collapsed if NCRC had not been in position to serve as the glue holding it together, pushing and iterating in uncertain times.

We are in a very strong position to move forward. We have identified research needs with stakeholders, established the in-country research platforms to support this research, and have further developed our partnerships to execute these research plans and use the knowledge generated by this work to maximize our development impact. Getting to this position has taken many years of hard work, patience and mutual understanding. What we lack now is the funding to take all this forward. Without significant funding from the next phase of CLARE, it will be much more difficult for us to progress our plans as an integrated whole, which we believe is their strength. It will be inevitable that we will have to move forward as a programme in parts dictated by the narrower interests of specific funding bodies and the availability of alternative funds.

In terms of research needs, we still see believe that to truly understand climate resilience we need to be able to move between scales both spatial and temporal. Climate change acts at large spatial and temporal scales, but people operate at much smaller scales, in our case at landscape and farm scales. As a result, big data analyses provide the large scale, long-term context for more detailed landscape-scale socio-ecological studies. This is we believe the research challenge that needs to be met.

Our CLARE project has shown that high quality research and dissemination can occur without international travel when there are strong in-country partners who are equal partners to the project with the capacity to gather critical data, inform and influence analysis, and share results with stakeholders. North-South partnership models in which there are complementary but distinct areas of expertise present a very promising model for reducing ECI impacts of future research. Investment in long-term project North-South relationships is something that IDRC should place significant emphasis in future.

Annex: Project outputs

Please include a list of all project outputs, engagement activities, and capacity⁶ strengthening from the project in tables such as those below. You can find a list on the online CLARE monitoring centre at your project review link (contact [Erika Malich](#) if you do not have this link).

As relevant, add further materials (e.g. agendas, meeting minutes, reports) that are relevant to this report.

Output Type (Journal article, blog post, etc.)	Title	Authors	Where it was published	Date of publication
Journal article	Climate change alters impacts of extreme climate events on a tropical perennial tree crop	Creedy, Thomas; Ashley Asare, Rebecca; Morel, Alexandra; Hirons, Mark; Mason, John; Malhi, Yadvinder; McDermott, Constance; Opoku, Emmanuel; Norris, Ken	The paper is currently submitted to the journal <i>Agriculture, Ecosystems and Environment</i>	
Technical reports produced by NCRC for project team and partners in relation to site visits and stakeholder workshops			Circulated to the Ecolimits team and partners during project	
Smartphone app	CoPod Cocoa Farmer App	CoPod and Ecolimits CLARE	Online	December 2021

⁶ Capacity strengthening includes award recipients (individuals) and activities run through projects (typically in a group setting, such as training or workshops).

Engagement event with stakeholders (event name and description)	Number of participants (% female)	Country where event took place (for virtual events, select the location of the main event organizer)	Date of engagement
Meeting with Cocoa Board Senior Managers and Directors to share preliminary results and gain feedback and further data sharing.	19 (16% females)	Ghana	June 2021
CLARE Ecolimits Stakeholder Consultative Meeting with Cocoa Private Sector	13 (31% females)	Ghana	December 2021
CLARE Ecolimits Stakeholder Consultative Meeting with Government Agencies—Cocoa Board and Forestry Commission	18 (33% females)	Ghana	October 2021
CLARE Ecolimits Stakeholder Consultative Meeting with NGOs and Research organizations	18 (39% females)	Ghana	October 2021
CLARE Ecolimits Stakeholder Consultative Meeting with Kakum Landscape Communities	23 (17% females)	Ghana	November 2021
CLARE Ecolimits Stakeholder Consultative Meeting with Kakum Landscape District Level Stakeholders	11 (45% females)	Ghana	November 2021
CLARE Ecolimits Stakeholder Consultative Meeting with Bia Landscape Communities and District Level Stakeholders	26 (19% females)	Ghana	December 2021

Capacity activity (award, training, etc.)	Name of activity	Participants (total participant number or awardee name)	Duration (in days / months)
Co-Pod workshop 1	Co-designing mobile application with Farmers & Community Representatives (Problem framing session)	Farmers (46 participants-28% females)	2 days
Co-Pod workshop 2	Workshop on the features and function of the Co-Pod app.	Farmers (21 participants-19% females)	1 day
Co-Pod training	Co-Pod app trial with farmers.	Farmers (15 participants-40% females)	2 days

