APCCO

The Agroforestry Paradox: Climate clever coffee

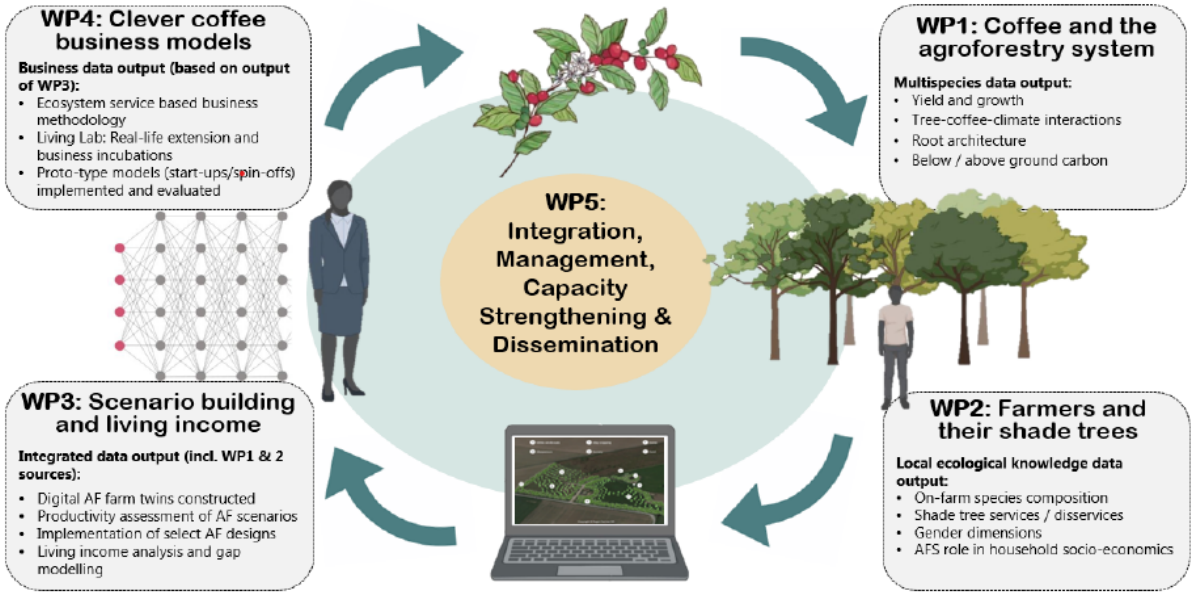
Internal Progress Report 1st year

Covering project activities from 1st October 2023 to 1st November 2024

Table of Content

Project overview

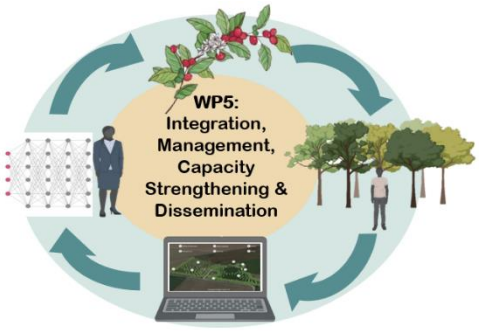
The APCCO project is about Ugandan coffee, the people who cultivate it and the environments in which it grows. The project will integrate new knowledge from multiple perspectives and disciplines concerning agroforestry (AF), incl. crop-tree-climate interactions and human ecological dimensions of AF, leading to an improved understanding of the agroforestry paradox – why AF practices are not more widespread than they are, given the known benefits of AF to the microclimate, the crop, ecosystem service provision, and ultimately farmers' income. In 4 work packages (WPs), we will collect and generate data from experimental and farm plots, listen to farmers during surveys and focus group discussions, apply a digital modelling tool to develop hyper-localized models of AF systems and their outputs, develop scenario-based AF decision support, and co-design new business models for producers, traders, and roasters leading to market-driven, inclusive coffee value chains based on climate-smart AF.



The project's objectives are:
(i) to uncover key interactions between shade trees, coffee plants, ecosystem services and the socio-economic and cultural context within Ugandan coffee AFS, and
(ii) to render a comprehensive understanding of and solution to the AF paradox by linking interdisciplinary research with cross-sector actors and development of new AF-based business models.

We hypothesize that the AF paradox arises at the interface between biophysical evidence, farmers' knowledge and decision-making practices, the institutions that surround farmers, and viable business models that remunerate farmers for the provision of a range of ecosystem services including coffee production. Only by understanding these factors and triangulating knowledge between disciplines will it be possible to design AFS that are climate smart, inclusive and economically viable.

WP5: Project management, integration and dissemination



WP5 is dedicated to the integration, management, capacity strengthening and dissemination of APCCO activities. Therefore, WP5 is presented first in this progress report, as it provides the general project overview, the main progress so far and plans for 2025 at project level.

The project management group consists of the two co-leads of each WP and at least one representative from each project partner. The table below describes the framework for how the project management group conducts project management, integration, capacity building, and dissemination activities.

Project Management • Develop and monitor project plans, timelines, and budgets. • Coordinate and oversee project activities. • Manage risks, issues, and changes. • Conduct regular progress meetings and reporting. • Ensure stakeholder engagement and communication.	*Integration* • Align project components with overall objectives. • Facilitate collaboration among teams and stakeholders. • Integrate lessons learned and best practices. • Coordinate cross-functional activities. • Ensure coherence and synergy among project elements.
Capacity Building • Identify capacity gaps and develop training plans. • Provide technical assistance and mentoring. • Conduct workshops, training sessions, and coaching. • Foster knowledge sharing and peer-to-peer learning. • Monitor and evaluate capacity-building effectiveness.	*Dissemination* • Develop and implement a dissemination strategy. • Prepare and share progress reports, newsletters, and publications. • Organize workshops, conferences, and knowledge-sharing events. • Utilize digital platforms for information sharing. • Develop and disseminate project outputs

Short narrative summary of WP5

The APCCO project was off to a good and early start with the hiring of four PhD students after a comprehensive application and assessment process. With the PhD students on board, the project inception workshop was held in Kampala in October 2023, where work package plans were presented along with administrative details, budget and more, before the APCCO team enjoyed two days in the field visiting project partners CURAD and NaCORI as well as a number of coffee farmers in the Mukono district. The first project year has since the inception mainly been focused on the development of PhD proposals and plans, a process that involves all project partners. In order to understand the local coffee context, the PhD students and a few MAK project

members went on a reconnaissance trip to two study areas in Mukono and Nakaseke. In October 2024, the students travelled to Denmark for their first research stays, where they will take courses, finalize PhD plans and plan the coming field work. At the end of January 2025, they return to Uganda and a year of data collection. Regular meetings have been held in the APCCO management group as well as at WP level, and file sharing in a OneDrive folder keeps all informed of project developments. A project website has been set up by MAK, while another will be created at IFRO in order to ensure timely dissemination of project activities at both primary partners. Though the research project is still young, a number of exciting reports have been made based on shorter field work stays in Uganda, including two MSc theses.

Main activities carried out so far and status of WP5

PhD Students and Inception phase

Before the project officially started on 1 October 2023, the calls for PhD students were developed and disseminated. The call attracted 58 eligible candidates for the 4 positions, of which 18 were shortlisted and invited for written tests and interviews with the presence of project team members in Uganda and online from Denmark. The four successful candidates were selected after the thorough assessment process, and the APCCO team welcomed Justine Nakibuule to WP1, Zerubabeeli Naturinda to WP2, Ezra Mwesigwa to WP3, and John Mugonya to WP4. The four students have also been enrolled at the University of Copenhagen (UCPH) as part of a double degree program, which requires two research stays in Denmark. Justine has been enrolled at the Department of Geosciences and Natural Resource Management (IGN), while Naturinda, Ezra and John have all been enrolled at the Department of Food and Resource Economics (IFRO).

With the PhD students on board, the inception workshop was held at the Forest Cottages hotel and conference venue in Kampala in mid-October 2023. Most project members were able to participate in the 5-day program, where all WPs were presented and discussed, details of the administration and budget were shared, and inspirational talks were given by a few project members regarding specific topics of relevance to APCCO. A social evening was spent at the Ndere cultural center at Kisaasi, before a two-day excursion started, first with a visit to CURAD and then a stay at NaCORI's field station. The final day brought the project members to a number of coffee farmers and a coffee processing site in Mukono.

The students are currently in Denmark for their first research stay (October 2024 to January 2025), where they are following MSc and PhD courses, finalizing their PhD plans and preparing for field work in 2025. Before their travels to Denmark, they presented their research proposals to the MAK supervisory team and the NARO-NaCORI Project Members for further guidance.

PhD Proposal development and reconnaissance

The time after the inception, the project has focused on the development of the PhD students' proposal, first for provisional admission to Makerere University (MAK) and later for full admission, which is still ongoing. As part of the proposal development, the four PhD students along with project members from MAK and NaCORI organized a reconnaissance trip from 15th to 26th April

2024 to Mukono and Nakaseke districts to select and visit future study areas and understand the local coffee context better. The trip included several focus group discussions (FGD) with coffee farmers and coffee community members, visit to coffee farms and interviews with the farmers regarding their agroforestry practices and shade tree selection and management, and key informant interviews. A large amount of data was collected during the trip, all of which is available in a comprehensive 82-page reconnaissance report written by the PhD students, with support from MAK and NaCORI supervisors. The report is available on the project's shared OneDrive folder.

The four PhD students participated in a training course on coffee improvement, production and protection in June 2024. The course was organized with the ROBUST research project, which is led by CIRAD and shares a few research topics with APCCO. The course provided the students with a thorough understanding of Robusta coffee, covering topics such as establishment, management, nutrition, pest and disease control, and diversification. The PhD students and four MAK colleagues participated in a 2-day First Aid course with a certificate at the Uganda Red cross Society Headquarters. This is part of the security measures that is funded by specific Danida funds to prepare the students for medical emergencies during prolonged field stays. A report documenting the training, including the specific exercises, is available on the shared OneDrive folder.

Administrative tasks and budget

The APCCO project has been formally registered at MAKs GAMSU - Grants Administration and Management Support Unit, which is a prerequisite for research projects at MAK. A website has been setup at MAK[1], and another is being set up at the Department of Food and Resource Economics (IFRO). The website has not yet been very active in terms of updates on the site with project activities. Efforts have now been put in place to improve this, but still more is needed in terms of contributions from project partners. A shared OneDrive folder has been created, where project documents can be shared at project and WP level.

Throughout the project, a number of project meetings have been held during the first year to support the ongoing development and implementation of project activities. Among these meetings are meetings in the management group, which consists of the two co-leads of the WPs and at least one representative from each project partner. Minutes from meetings are available in the project OneDrive folder.

The DFC, who coordinates Danida projects, has transferred funds for 2023 and 2024 to IFRO and IGN, corresponding to 3.176.289 DKK, which does not include expenses for the first PhD research stay in Denmark. These expenses are managed by DFC directly. Funds have been transferred to the primary partners according to the project budget for 2023 and 2024. The first financial

[1] https://caes.mak.ac.ug/research-projects/agroforestry-paradox-climate-clever-coffee-apcco-project/ The MAK webpages are undergoing a major revision. The APCCO website is therefore in a simple setup until the revision has been implemented.

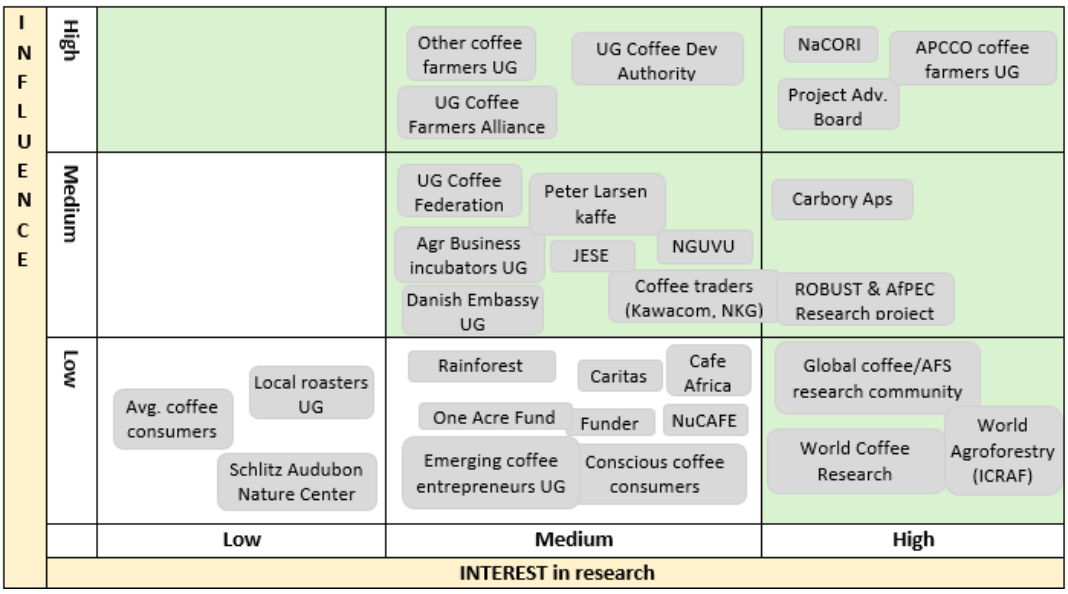
reporting will be done in the first months of 2025, according to a process and schedule that will be shared with all partners. The detailed project budget is available in the project OneDrive folder.

DFC has agreed to reallocate funds from the 2nd PhD study stay in 2026 to cover additional weeks during the first stay in 2024/25. This means the first stay is prolonged from 3 to 4 months, and the second stay is reduced correspondingly. This was agreed among the management group, so the PhD students have sufficient time to follow courses while at UCPH.

The APCCO project has set up an advisory board, consisting of Samuel Kyamanywa, Professor at MAK, Joseph Nkandu, executive director of NUCAFE, and Moses Nyabila, CEO of aBi Development limited. The advisory board participated in the inception meeting and interactions are planned at a minimum of once per year in relation to the annual progress reporting.

Stakeholder engagement plan

In October 2024, Jenipher and Aske attended a 4-day training organized by DFC on Stakeholder engagement, influencing and impact. As a result of this training and with inputs from project partners, we mapped the relevant stakeholders, who have an interest in the APCCO project and have an influence on the achievements of the project's planned goals. See figure below. We also developed a draft APCCO project Stakeholder Engagement Plan, which consist of the engagement approach towards each identified stakeholder and planned activities for the different phases of the project: the inception, project implementation, project scale up/out. These will be discussed with project partners in order to finalize the engagement plan. The draft will be available in the project OneDrive folder. DANIDA has an open call for small grants for engagement activities with deadline in February 2025. APCCO will apply to this call for engagement activities in 2025.



Main activities planned for 2025

The year 2025 will be a busy year for APCCO, as the four PhD students return from Denmark at the end of January and will start their field work and data collection. This will continue for the remainder of 2025, with support in the field and behind the desk of MAK supervisors and project members from Denmark and elsewhere. While some supportive activities will be online, due to the international team of APCCO, other activities will involve field work by senior researchers in the study areas as well as bringing equipment for the experimental trials.

While the Mukono and Nakaseke districts have been selected as the study areas, the selection of farmers for specific data collecting activities are yet to be selected. The experimental trials for WP1 will also be selected as part of the preparation to prolonged experiments for shade and drought studies, which will span two years of data collection.

Participating senior researchers from MAK and NaCORI will make a short visit to the University of Copenhagen, as part of a knowledge exchange. The visit is not yet planned.

Images

(Part of) the project team at the project inception meeting.

Naturinda, John, Ezra, Justine and colleagues from MAK at the first aid course.

Focus group discussion held during the reconnaissance trip in Bukonero Village Kimenyedde subcounty in Mukono District.

WP1: Coffee and the agroforestry system

WP1 investigates biological and agricultural aspects of the Ugandan Robusta agroforestry systems with focus on climate change. Climate stressors and tree-coffee-environment interactions will be studied across a range of farms in UG presenting different conditions in terms of precipitation and elevation, and under shade and drought conditions.

Short narrative summary of WP1

WP1 will investigate how shade and shade tree species in UG coffee AFS affect coffee plants. Robusta coffee-producing farms will be identified in collaboration with WP2, and farms will be selected to cover a shade gradient from open-field (full sun) to mature/dense AF. Plots will be established under selected shade tree species and in the open, applying an imbalanced block design and assessments carried out on both field and plot levels. In a second research design, WP1 will set up infrastructure to study the effects of shade on Robusta performance. This will be done on-station through the establishment of shade nets above rain interceptors in a replicate block design. The main activity during the first year has been the recruitment and enrolment of PhD student Justine Nakibuule. Justine has been enrolled at both Makerere and Copenhagen Universities and has elaborated her research plans (reflecting the aims above) in collaboration with supervisors. Field work will begin in 2025, starting with final selection of location for the experimental plots.

WP1 Research questions

The objective of WP1 is to elucidate critical interactions between UG Robusta AF and coffee productivity, carbon sequestration and responses to abiotic/biotic stresses. The specific research questions remain as stated in the APCCO project description:

- How are Robusta coffee yield and phenology affected by AF compared to full-sun systems (FS)?
- What is the carbon sequestration potential in AF and FS Robusta coffee systems?

- How do abiotic (e.g., drought) and biotic (pests and diseases) stresses influence Robusta coffee (yield, quality) under AF and FS?
- Which shade tree species are compatible with Robusta AFS in terms of microclimate moderation, low occurrence of pests and diseases, nutrient and water competition?

Main activities carried out so far and status of WP1

A call for PhD students under WP1 was advertised prior to project start-up. We received 19 eligible applications that were assessed, and 5 suitable candidates were subsequently selected for written and oral interviews. The successful student was selected and started on the development of her full proposal for acceptance as a double-enrolled PhD student. The main activity during the first year has thus been the recruitment and enrolment of the PhD student Justine Nakibuule. The formal enrolment at University of Makerere was completed in April 2024, while the enrolment at University of Copenhagen was completed in September 2024. During the process, Justine has written, presented and revised her PhD plan, based on inputs from members of WP1 and academic supervisors. As such, she successfully defended her PhD proposal at Makerere University (Mak) and has completed the first PhD courses. Justine also participated in the reconnaissance travel (see below) to identify suitable sites for the on-farm studies and at National Coffee Research Institute (NaCORI). With the other PhD students, Justine recently traveled to Denmark for her first research start to further develop the plan and methodologies with supervisors at University of Copenhagen.

A reconnaissance study was conducted in the districts of Mukono (15TH -19TH April 2024) and Nakaseke (22nd -27th April 2024) to visit coffee AF farms. The study involved partners from NaCORI and Makerere university. A pilot study was conducted, studying the existing coffee agroforestry systems, and at the same time informing farmers about the project. This information was used to determine the required sample sizes for future studies and also plan appropriate experimental design. In each district, focus group discussions were conducted with Robusta coffee agroforestry farmers, and thirty Robusta coffee agroforestry farmers were visited. Shade trees in each farm were identified, documented and its parameters such as DBH, crown width and height were enumerated.

Main activities planned for 2025

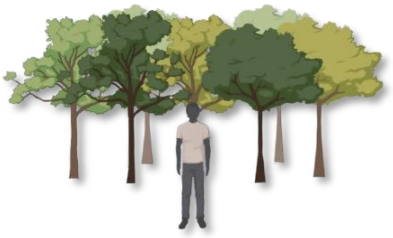
2025 will be the year of establishment of farm plots and field trials. During her stay in Denmark, Justine will be trained in statistical designs, assessment methodologies and different eco-physiological equipment, making her ready to establish the trials when she returns to Uganda.

For farm plots: Trials will be established based on preliminary inventories of trees, carried out in collaboration with WP2 during the reconnaissance travel. A number of tree species will then be selected (8-10 species), and approximately 10 plots will be established under each species.

For on-station trials: These trials will be established on the NaCORI field station, using established coffee plantations. Two trials will be established, (1) A trial with many levels of shade, and (2) A trial with shade in combination with reductions in water supply to mimic effects of drought.

In all trials, monitoring of phenology, physiology and yield will start as soon as the trials have been established, to continue for at least two years.

WP2: Farmers and their shade trees



WP2 will uncover farmers' perceptions and adoption of Robusta AFS, by assessing on-farm tree species diversity, socio-economic aspects and farmers' local ecological knowledge of trees and their services and disservices to coffee farming and the farming households.

Short narrative summary of WP2

WP2 aims to explore the reasons why farmers plant and maintain trees in Robusta coffee farms, focusing on socioeconomic, climatic, and ecosystem dimensions. Using a mixed-method approach, this work package will primarily investigate farmers' perspectives and preferences for planting or retaining specific tree species and individual trees on their farms. It will examine the abundance of these trees, the synergies between the trees and coffee plants, and farmers' understanding of ecosystem services. Additionally, the work package seeks to determine the relationship between on-farm tree diversity, farmers' agroecological knowledge, and the contribution of trees to climate change adaptation. Sarah, co-lead of WP2, has moved affiliation from MuZardi Mukuno to NaCORI.

WP2 Research questions

The objective of WP2 is to uncover socio-economic and cultural aspects of Robusta AFS adoption and practices among smallholder farmers in UG. The original main and specific research questions in the PD have been altered as shown below in the table.

Original research questions	Updated research questions
How does local ecological knowledge (LEK) and gendered selection of tree species affect smallholders' adaptive capacity and resilience in Robusta AFS?	What is the farmers' knowledge about trees in Robusta coffee farms, and the factors that influence their integration in agroforestry systems?
1) How diverse are Ugandan Robusta (AF) coffee smallholder farms in terms of shade tree species richness? 2) What are the cultural and socio-economic reasons for (non)adoption of Robusta AF systems, including perceived ecosystem services and disservices of shade trees? 3) How do shade trees contribute to the household economy?	1. How do farmers perceive and understand the ecosystem services and disservices provided by trees on Robusta coffee farms? 2. What are the socio-economic factors influencing farmers' choice of retaining trees on Robusta coffee farms? 3. How does tree integration on Robusta coffee farms help smallholder farmers adapt to climate variability?

The reason for this new formulation is to encompass a broader understanding of the possible reasons for integrating trees in coffee agroforestry systems. While local knowledge remains a significant component in the updated proposal, we now include three dimensions of analysis: economic, ecological, and climatic reasons for integrating trees. This approach aligns with the initial objective to uncover socioeconomic and cultural aspects of Robusta AFS adoption and practices among smallholder farmers in Uganda. We will also maintain a focus on gender in our analysis, consistent with the original PD.

In the current proposal, we have slightly adjusted the research questions. We have removed the research question (RQ) about tree diversity and will explore this within RQ2, as the farmers' knowledge dimension on tree species is more relevant for this work package than conducting a tree inventory. Data on on-farm tree species diversity and abundance will be gathered through free listing exercises during the survey. The tree inventory has been covered by two MSc students in connection with WP1, and we will obtain data from the shade tree advice study from Robusta farms in Uganda. This means we will be able to identify most tree species used in agroforestry systems (AFS) in Uganda.

We have also made the climate adaptation component more prominent in the research of WP2, as seen in RQ3 (below). Finally, the contribution of trees to household (HH) economy will be covered in WP3. Therefore, the focus of WP2 will be on analyzing the socioeconomic incentives for keeping/planting trees on farms. We have removed the last RQ in the PD and added a new RQ1 to the current proposal.

As the research proposal is still under development, the adjusted research questions are subject to modification.

Main activities carried out so far and status of WP2

1. Among many good candidates, Zerubabeeli Naturinda was selected and hired as a PhD student in WP2.
2. All members of WP2 participated in the Project inception workshop in Uganda, October 2023
3. We conduct meetings between the WP leads (Dr. Turreira from UCPH, Dr. Mutonyi from NaCoRi), Naturinda, and the PhD supervisor from Makerere, Dr. Egeru as needed. The meetings include supervision and technical guidance for proposal development and presentation
4. In April 2024, the study areas for WP2 activities were selected, and the sampling strategy planned.
5. Naturinda has completed the following activities in relation to the APCCO project:
    - Completed the full draft proposal and submitted it to the Doctoral supervisors and committee.
    - Completed drafting the research data collection tools.
    - Held 10 online and physical meetings with his supervisors to provide guidance towards improving the research proposal.
    - Held a number of meetings with work package leads.

- Received the provisional admission at the School of Forestry, Environmental and Geographical Sciences, College of Agricultural and Environmental Sciences, Makerere University, Kampala as a 2023/2024 Academic year entrant.
- Conducted a reconnaissance study in the districts of Mukono and Nakaseke in April 2024, provided a report and made a presentation to the APPCCO Project team on 08/05/2024.
- Held the first Doctoral Committee meeting on 25/4/2024, with feedback given.
- Enrolled for the Double PhD degree at UCPH_SCI_IFRO 2024/2025.
- Registered for PhD and Master courses at UCPH.
- Started the first stay at UCPH-IFRO (September 2024-January 2025).

6. Three MSc students from UCPH have completed a 6-week research stay at NaCoRi as part of their MSc program in Environment and Development. The students focused their research on the Traditional Ecological Knowledge of Robusta coffee farmers and their adaptation strategies to climate change. This research will produce a report and generate relevant data for planning the upcoming fieldwork for WP2. The MSc students were supervised by Dr. Turreira and hosted at NaCoRi by Dr. Mutonyi, which has strengthened the collaboration between the two institutions.

The original Gantt chart for WP2 has been updated:

Main activities / Year / Quarters	2023				2024				2025				2026				2027				Description of milestones
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	
Identification and selection of study areas																					1. Random sampling of Robusta farms. 2. Farmer interviews, survey and Q-methodology done. 3. 1st paper published
Research proposal completion																					
Data Collection (Interviews, survey, etc.)																					
Data analysis																					
Research output writing																					
Data exchange to/from QP1,3&4																					
Milestones									1				2		3						

Main activities planned for 2025

- Finalize Naturinda's PhD proposal (January 2025)
- Hold PhD start up seminar at UCPH in January 2025
- Hold PhD Proposal defense at Makerere University
- Hold work package meetings
- Complete PhD courses and Master's courses at UCPH
- Pre-test and finalize the data collection tools
- Start data collection, management, and analysis
- Produce first research paper
- Hold 2nd and 3rd doctoral committee meetings for Zerubabeeli Naturinda.

- Senior Researchers' visit to University of Copenhagen.

Images from the field

PhD students Zerubabeeli Naturinda and Justine Nakibuule in a Robusta coffee farm that has integrated *Ficus natalensis* (Mutuba) tree. Photo by Ezra Mwesigwa

Three MSc students from the University of Copenhagen, Inge, María and Anton, together with the PhD student Zerubabeeli Naturinda, during an interview with a Robusta coffee farmer

Talk given by the town council official during a focus group discussion in Kasawo- Mukono district during reconnaissance visit. Photo by Zerubabeeli Naturinda

WP3: Scenario building and living income

WP3 will assess the potential impact of digital tools on the design and adoption of hyper-local AFSs and living income gap in Uganda. WP3 will assess the most suitable models concerning feasibility, data availability and accuracy requirements for modelling hyper-local Robusta AFSs in Uganda using digital twins of a number of representative coffee farms. Based on empirical data from a farm and farmer survey, living income gaps among farmers will be assessed and the most important income drivers from the coffee agroforestry systems will be studied in digital scenarios.

Short narrative summary of WP3

In October 2023, the WP3 project team met with all APCCO colleagues in Kampala for the official Inception Workshop, arranged by Makerere University. The selected PhD student, Ezra Mwesigwa, sent in his final PhD proposal, carried out a reconnaissance trip together with the other APCCO PhDs students to robusta coffee farmers, and traveled to Denmark to prepare for the first courses and to finalize his PhD plans as part of his double-degree enrollment at the universities of Makerere and Copenhagen. Several meetings were held with members of the ROBUST project team, led by CIRAD, to build synergies and share experiences and methods. In extension of this, data requirements for model calibration and potential challenges/bottlenecks in methodologies were discussed to plan for the upcoming data gathering on farms in Uganda. Assessment of model suitability and feasibility was undertaken, to ensure data gathering is aligned with data requirements in model calibration. This included data requirements for the Living Income baseline.

WP3 Research questions

The research questions in the original project proposal have been amended slightly to accommodate new insights into the context of digital farms, data, and coffee systems in Uganda. The table below explains the details.

Current research question	Comments to research question
To what extend can existing biophysical models for ecological and economic modelling be calibrated to accurately model Robusta AFS in Uganda?	Though no changes in the research question, an overall hypothesis has been proposed that will be validated in the project. The hypothesis is that a dynamic setup, where several models are selected and calibrated, will bring the best modeling results for farms with specific types of production robusta system. As such the question is not “which model is best”?, but rather “which suite of models best cover most of the potential solution space with best accuracy?”. This is not an alternative research question, but rather a comment/further specific on the approach and work being done to answer this research question.

If so, how can hyper-local, scenario-based digital support tools increase AFS adoption?	The previous research question was biased, and there changed to include "if".
How do Robusta FS/AFS affect farmers' ability to earn a living income?	As it has been deemed necessary to narrow the scope of the project, it has been decided to exclude cup quality premium as a strategy to increase Living Income through agroforestry. More specifically, modeling of cup quality premium as a robusta agroforestry business model and Living Income gap reduction strategy will not be prioritized since, A. it is likely not possible to model with high accuracy, B. it would require the gathering of large amounts of additional data with methodologies that are currently not planned within the project, and C. the underlying hypothesis of increased cup quality in robusta agroforestry systems has not been validated, and as such it is a big leap to use resources on this business model. The two main business models for further AFs modeling work and Living Income scenario modeling are income diversification and ecosystem services.
What are the potentials of ecosystem services-based Robusta AF farming on living income gap reductions (scenario-based modelling)?	Remains unchanged.

Main activities carried out so far and status of WP3

The following activities were completed between October 2023 and November 2024:

- Work package members attended and completed a 5-day Project inception Workshop in Kampala, Mukono and Nakaseke districts. (Makerere, New Foresight, Regen Farmer)
- Additional co-WP lead assigned (Makerere)
- Coordinating meetings with Robust project team to build synergies between the projects and learn from their experience and challenges with a similar project. (Regen Farmer and Makerere)
- Analyze data-streams within project. (Regen Farmer, Makerere and University of Copenhagen)
- Model suitability assessment and technical feasibility study of suitable models. (Regen Farmer, Makerere and University of Copenhagen)
- Input on data requirements for Living Income analysis. (New Foresight)
- Input on data requirements for plot scale performance model calibration and farm scale economic and environmental model calibration. (Regen Farmer)

- The PhD student, Ezra Mwesigwa, was double-enrolled and registered at the Department of Food and Resource Economics (IFRO), UCPH, and at Makerere University for Semester 1, Year 1, Semester 1 Year 2. (Makerere)
- Ezra completed the Graduate Students Orientation organised by Forestry Biodiversity and Tourism (FBT) at Makerere University, and the Agroforestry Course with a Certificate at Makerere University and the National Coffee Resources Research Institute (NaCoRI) under the ROBUST Project.
- Two Proposal Presentations at the Department of Forestry Biodiversity and Tourism (FBT) on the 5th of September and 24th September 2024.
- Field reconnaissance trip in Uganda. Visiting robusta coffee growers. (Makerere)
- Ezra is currently undertaking the first research stay at the University of Copenhagen, with the purpose of finalizing his PhD plans and taking course. The following courses have been completed or are in progress: Two master courses: Agroforestry and Developing Interdisciplinary Green Solutions**;** two mandatory General Data Protection Regulation (GDPR) Courses with a Certificate from UCPH, one for staff and one for students; and a mandatory course on Responsible Conduct of Research-RCR at UCPH with a certificate.

Status of the WP

- PhD activities progressing as planned.
- Digital twins only possible to finalize with data from the individual farms in 2025. Previously planned for 2024.
- Other activities progressing as planned.

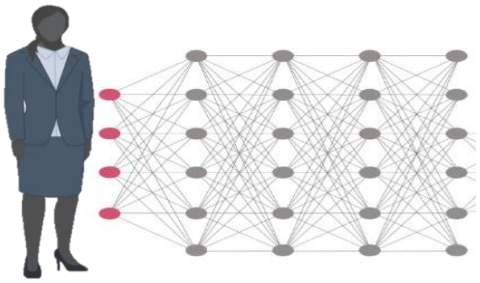
Main activities planned for 2025

The following activities are planned for the coming period (2025):

- Conduct a PhD Startup Seminar at IFRO. A mandatory seminar presentation about the proposed study approach. The seminar targets feedback from the participating audience as a way of developing a feasible research strategy.
- Full admission at Makerere University. Ezra was provisionally admitted for 1 year as per policy. Full admission will be granted upon successful proposal defense at the department. This requires only the completion of a compliance form that addresses issues raised by supervisors at Makerere.
- Model Parameterisation and Calibration of the selected model to be run with RegenWorks. Define and localize Key Parameters of selected models.
- Farm Level Data collection through a farmer survey, developed and implemented in collaboration with WP2. For digital twins, income drivers and model calibration will be performed.
- First Paper Publishing (AFS Adoption).
- Establish Living Income Benchmark for Uganda

Images from the field

WP4: Clever coffee business models



WP4 will develop ecosystem service-based business models that integrate Robusta agroforestry systems and are socially desirable, technically feasible and economically viable for the UG coffee sector. This will be done through continuous interactions with farmers, coffee traders, roasters and other stakeholders, amongst others, using workshops to discuss scenarios of business development.

Short narrative summary of WP4

WP4 began early with the recruitment of a PhD student, John Mugonya. John has since been supported by the WP4 team at Makerere, UCPH and CURAD to develop his PhD proposal, which has been successfully defended, which means that John is now a full PhD student at Makerere University. John has also been enrolled as a double degree PhD student at UCPH, where he is now enjoying the first research stay in order to complete a number of courses and finalize his PhD plan. Key to WP4 and APCCO is the project partner CURAD that has the goals of supporting research at Makerere University and endeavoring to turn research outputs into business or into impactful outputs that can support the youth, women and farmers; fully aligned with the goals of WP4 and of APCCO in general. During the first year, John has enjoyed access through CURAD to coffee sector stakeholders, who may be relevant as respondents or advisors in executing the study, as well as received inputs to his conceptual framework. The main field activity was the reconnaissance trip to Mukono and Nakaseke to map out project areas and participants.

WP4 Research questions

The table below contains the original WP4 research questions, as well as those specifically developed the John's PhD study. This is a work in progress.

WP4 Research questions	PhD project research questions
1. Which specific demand-side and local supply-side conditions need to be considered in the design of integrated AF-based coffee business models?	1. What are the effective pathways to increase adoption, scaling and sustainability of agroforestry ecosystem services-based business models among smallholder coffee farmers?
2. Which types of local support/services are needed to introduce, scale and sustain a climate-smart coffee business model in UG?	2. What mechanisms foster innovation in ecosystem services-based business models in smallholder coffee agroforestry?
3. How can innovative market platforms and agribusiness incubators support and drive implementation of ecosystem service-based (e.g., carbon) coffee business models?	3. How can business models for agroforestry ecosystem services effectively integrate smallholder farmers?

Main activities carried out so far and status of WP4

The main activities in WP4 so far include:

- Identifying and recruiting the PhD student for WP4 - John Mugonya, including provisional admission and registration of the student at MAK after a successful defense of the PhD proposal at MAK
- Supporting progress of John at Makerere university to craft, refine, submit and present for full enrollment at Makerere
- Double enrolment of John at University of Copenhagen
- Reconnaissance study, 1st aid course, and training course organized in the Robust project.
- Monthly student supervision meetings and a doctoral committee meeting

Main activities planned for 2025

- John will present his PhD proposal at the start up seminar at UCPH in January 2025
- Apply for research Ethics Review Board approval at MAK, and investigate if the same is needed for UCPH at PhD level or at project level only
- Complete systematic literature review
- Complete the first journal paper based on systematic literature review
- Develop and pretest data collection tools
- Collect data and start data analysis
- Continuing with monthly PhD supervision meetings

Images from the field

Reconnaissance meeting in Nakaseke district, April 2024

Farm field visit in Nakaseke, April 2024

Outputs from APCCO project – year 1

It is too early to include a quantitative overview of outputs from the project in line with the log frame from the proposal. However, the APCCO project as already yielded a number of interesting and relevant research documents and reports.

The reconnaissance trip by the four APCCO PhD students, Justine, Naturinda, Ezra and John, and the lessons learnt, and information gathered through interviews, FGDs and farm visits have been documented in a comprehensive field report, available at the APCCO shared OneDrive folder.

Though not directly funded by the APCCO project, two journal chapters have been authored by project members regarding topics that are central to our APCCO project. A journal chapter to Advances in Botanical Research goes in-depth with the role agroforestry practices play in future coffee production. The chapter "…provides a palatable assortment of arguments, evidence and insights surrounding the feasibility and sustainability of agroforestry in coffee production". In the same journal another chapter explores the effects of climate change in relation to the coffee crop and its nine major pests and diseases, partly based on data from Uganda.

Koutouleas, A., Bosselmann, A.S., Rahn, E. 2024. Is agroforestry a sustainable management system for future coffee production? https://doi.org/10.1016/bs.abr.2024.05.001

Koutouleas, A., Arias, M., Barrera, J.F., Zewdie, B., Kagezi, G., Ssekiwoko, F., Avelino, J. 2024. Impacts of climate change on pests and diseases of coffee in East Africa and Mesoamerica https://doi.org/10.1016/bs.abr.2024.03.002

Two MSc students from University of Copenhagen, Nanna Astrup Eriksen and Tim Jansen, conducted their thesis fieldwork in Uganda under the joint supervision of partners from MAK and UCPH. The thesis concerned associations between robusta agroforestry types and bird diversity in the systems, and was successfully defended at UCPH, receiving the top grade. The main conclusion of the study is that coffee agroforestry supports a substantial bird diversity, but that the species composition differs from what may be observed in adjacent forests.

A MSc student from University of Copenhagen, Mads Bak Sørensen, carried out his thesis fieldwork in Uganda under the joint supervision of partners from UPCH and from Kawacom, a coffee processing and trading company and external partner to the APCCO project. Mads investigated the implementation of the EU Deforestation Regulation in the Ugandan coffee sector and how different actors in the coffee value chain respond to the new regulation. With relevance for the APCCO project, the thesis highlights the role of coffee companies and public sector actors in the support of coffee farmers when faced with new market requirements.

Three MSc students from UCPH have completed a 6-week research stay at NaCORI as part of their MSc program in Environment and Development, under the joint supervision of UCPH and NaCORI. The students, Anton Bryntesson, Maria Gallardo Urbón and Ingeborg Irati Díez Elizalde focused their research on the Traditional Ecological Knowledge of Robusta coffee farmers and their adaptation strategies to climate change. Their research has produced a report and generated relevant data for planning the upcoming fieldwork for WP2.