EU-UNEP Africa Low Emissions Development Strategies (Africa LEDS) Project

Final Progress Report

Reporting period	**12/04/2016 – 17/09/2019 Last Report**

Description

ENRTP/GPGC strategic priority	Climate change	EC Directorate General	DG CLIMA
UNEP/MEA programme of work	UNEP programmes of work 2016-2017, 2018–2019		
Project title	EU–UNEP Africa Low Emissions Development Strategies Project (short title: Africa LEDS Project)		
Geographical coverage	Cameroon, Côte d'Ivoire and Democratic Republic of the Congo for Component 1 and 2, plus: Ghana, Kenya, Mozambique and Zambia for Component 2. In addition, a sub-regional and region-wide component		
Date of EC–UNEP agreement signature	15/03/2016		
Project start date	12/04/2016	Project end date	11/10/2019
Overall project duration	42 months		

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1. Context and Summary of the Action

1.1 Context

The African continent stands out for its disproportionate vulnerability to the changing climate. Scientists estimate that over the past 100 years, temperatures across Africa have increased by an average of 0.5 – 2 degrees[1]. It may not sound significant, but the impacts are life-changing. From changing weather patterns that reduce crop yields in Malawi, to natural disasters which threaten lives in Southern Africa, or the 2018 crisis that saw Cape Town facing 'Day Zero' without water, the fall-out of the changing climate is evident across this continent. Sixty-five percent of the African population is likely to be impacted by the consequences of climate change – despite the fact that African nations are responsible for just 2-3% of global emissions[2].

In supporting the continent build resilience against these impacts, the European Union-United Nations Environment Program (EU-UNEP) Africa Low Emissions Development Strategies (ALEDS) project, implemented over 3 years and 6 months, supported countries in Africa to put in place a structure to guide optimal implementation of their climate commitments to the Paris Agreement. These commitments are called Nationally-Determined Contributions (NDCs). NDCs are the overarching, globally-approved Low Emissions Development Plans by each party to the Paris Agreement. Work was covered through three components and was focused in seven partner countries - Cameroon, Côte d'Ivoire, the Democratic Republic of Congo (DRC), Ghana, Kenya, Mozambique and Zambia, with broader peer learning across the continent.

Component 1. LEDS Planning and Implementation Support: under Component 1, undertaken in Cameroon, Côte d'Ivoire, and the Democratic Republic of Congo, support was provided at the strategic, policy planning level, with demonstrations done to validate policies and plans. The aim was to identify and bridge policy gaps, undertake capacity enhancement through training and technical assistance, and conduct an anchor demonstration project to inform planning, design, and implementation of practical LEDS consistent with the respective country NDCs.

Component 2. Low Emissions Development Strategies (LEDS) Modelling Support: under Component 2, support was provided to all the 7 countries to establish strong analytical frameworks for facilitating long-term LEDS policy decision making consistent with respective country climate objectives and socio-economic development priorities, as stipulated in their NDCs and development visions.

[1] https://cdkn.org/wp-content/uploads/2014/04/AR5_IPCC_Whats_in_it_for_Africa.pdf
[2] http://unfccc.int/files/press/backgrounders/application/pdf/factsheet_africa.pdf

Component 3. Peer Learning and Lessons Exchanges: work in the above two components informed continental peer exchanges and lessons sharing to catalyse continent-wide replication and upscaling of the project results.

1.2 Summary of Action

Component 1 involved local ground actions (pilot projects). These actions practically demonstrated how implementation of NDC commitments aligned to leading socioeconomic priorities can be combined to unlock enterprise opportunities. Results of these practical actions were fed back, through case-studies, to inform government-wide policy planning for NDC implementation prioritisation. This feedback was provided through an inter-ministerial policy taskforce, made up of policy actors from environment and resource ministries and non-environment ministries whose sectors are prioritised in the NDCs. These policy actors are the same as those who would oversee the implementation of actions prioritised in their respective NDCs. Collaboration among these actors is key to successful LEDS policy implementation, since there are often specific actions needed by each actor (e.g. across both the agricultural and energy sectors).

- In **Cameroon**, the ground demonstration action involved greening the countries agro-value chains using nature-based, climate-smart agricultural approaches for on-farm production, clean energy to power agro-processing, and Information and Communication Technology (ICT) digital tools for connection to markets – in place of business as usual (BAU) paper processes and product transport that has a higher carbon footprint. This demonstration covered NDC priorities in agriculture, energy, forestry, and transport. The ground action was done at two sites – Jakiri municipality and the Ngoulemakong municipality. Jakiri involved linking a micro-hydro plant to power milling of cassava sourced from a local cooperative into flour. This flour was then marketed using a digital ICT tool called AfroShop. At the Ngoulemakong municipality site, solar driers were used to dry cassava for preservation and preparation for processing. Results were compiled into case studies and shared with policy makers through the Ministry of Environment that convenes the interagency policy taskforce.
- In **Côte d'Ivoire,** ground demonstrations focused on smart rice cultivation practices and rice milling by-products recovery for energy use. Specifically, by-products recovery for energy use refers to conversion of rice husk to fuel briquettes for use as cooking fuel. This process covered NDC priorities in three of the highest emitting sectors in the country – agriculture, energy and forestry. This pilot addresses forestry because the rice husk briquettes produced offset charcoal and the associated unsustainable local wood harvests. Climate smart rice cultivation pilots were conducted at two sites - Tipadipa and Tietiekou outside of Gagnoa (south-central Côte d'Ivoire). The rice farm pilots plots were 50 hectares in size. Smart practices included rice straw composting (and use as fertilizer), intermittent irrigation (instead of continuous flooding), and the use of higher yielding seedlings and planting techniques. BAU practices include continuous flooding (with high

methane emissions), use of mineral fertilizers, and lower yielding seeds and planting techniques. Separately, a rice husk briquetting process at a small woman-operated mill in the town of Gagnoa was also evaluated. Rice husk is a low value by-product left over at a rice mill. Production and local use of rice husk briquettes as a cooking fuel offsets the use of BAU fuels, including charcoal and kerosene. If rice husk briquettes can successfully enter the local market, then lower demand for charcoal will support recovery of local forests. Results were compiled into case studies and shared with the inter-agency policy taskforce which brings all the ministries together including the Ministry of the Environment as the lead.

- In the **DRC**, the ground demonstration focused on waste to energy, where general and organic waste was converted to biogas and fuel briquettes. This covered NDC priorities in energy, forestry and waste management. Work was done at two sites – the "Higher Institute of Applied Techniques" premises in Ndolo municipality was used for biogas production (organic waste to biogas) and households in Barumbu municipality were used for testing the briquettes (general solid waste to fuel briquettes), also produced in Ndolo.

Based on the results of the ground actions for each of the three countries, case studies were compiled into final reports. These project lessons will inform policy decisions for long term sustainability of project products.

Component 2: under this component, the focus was on analytical modelling. Here, integrated modelling frameworks, capable of forecasting the long-term climate and socio-economic impacts of alternative NDC implementation trajectories, were developed. Each country developed its own integrated modelling framework by enhancing existing modelling tools and filling gaps with new tools. Individual modelling tools were then linked into integrated policy analysis frameworks. Training of policy makers, convened under the policy taskforces, was also conducted. The modelling frameworks were designed to equip policy makers with decision support tools to inform them on optimal NDC investments through metrics addressing prioritised and expected economic, environmental and social outcomes. This component was implemented in 7 countries.

- In **Cameroon**, stakeholders developed an indigenous model – a customised model that can forecast simultaneous climate and socioeconomic impacts of greening Cameroon's agro-value chain. The analysis was done using data from the ground demonstration under Component 1 and extrapolated impact nationally and over time up to 2035, the year the national development strategy, Vision 2035, is set to expire.
- In **Côte d'Ivoire**, stakeholders developed an integrated model combining existing tools of the Long-range Energy Alternatives Planning System, Integrated Benefits Calculator (LEAP – IBC), the Ex-Ante Carbon Balance Tool (EX-ACT), the Center for Climate Strategies' (CCS) LEDS toolkit, and a geographic information system (GIS). This integrated framework was applied to forecast energy, emissions, resources, and socioeconomic impacts of investing in agriculture,

biofertilizer, and agricultural by-products-to-energy systems as demonstrated under Component 1. Impacts were extrapolated through 2050 and scaled-up to the national level.

- In **DRC**, stakeholders modified the Model for Assessment of Energy Demand (MAED) model to forecast simultaneous climate and socio-economic impacts of investing in waste-to-energy systems towards meeting the national development priority to distribute 1 million improved cookstoves.
- In **Ghana**, stakeholders developed an integrated model combining existing tools of LEAP and REDD Abacus to forecast simultaneous climate and socioeconomic impacts of investing in renewable wood / plantation forests and improved cookstoves towards meeting national priority to distribute 2 million improved cookstoves and convert 12,000 ha per annum of degraded area to wood plantation.
- In **Kenya**, stakeholders developed an integrated model combining existing tools of LEAP – IBC, Abacus and I-JEDI to forecast simultaneous climate and socio-economic impacts of investing in clean cookstoves and agroforestry towards meeting national priorities on domestic energy and forestry stipulated in the NDCs, the National Climate Change Action Plan (NCCAP) and the farm forestry policy aims to increase forest cover to at least 10% by 2030.
- In **Mozambique**, stakeholders developed an integrated model combining existing tools of REDD Abacus and LEAP to forecast simultaneous climate and socioeconomic impacts of investing in agroforestry and solar powered irrigation to achieve national priority to scale up agroforestry to 4million hectares and irrigation coverage to 90,000ha.
- In **Zambia**, stakeholders developed an integrated model combining existing tools of LEAP, I-JEDI, DIA (Development Impact Assessment), and AFOLU Analysis Tool to forecast simultaneous climate and socioeconomic impacts of investing in assisted natural regeneration and sustainable agriculture (organic fertiliser) for land use and clean cookstoves and mini-grids (solar and micro-hydro). These were strategic to drive NDC priorities in energy, agriculture, forestry and land use.

Component 3: the focus of this component was peer leaning and lessons exchanges to ensure continental wide replication and upscaling of the project results. The project brought together countries at the continent-wide level under an AFOLU-focused community of practice (CoP) to share lessons from the project and catalyse implementation of key climate actions. The CoP focused on learning in three dimensions: modelling methods and tools, linking across agriculture and small-scale energy solutions, and use of modelling to inform national policies. This component of the project focused on peer learning and knowledge exchange on successful and innovative approaches arising from the project. This learning and knowledge sharing occurred both among project countries and across the African continent. Several remote interactive learning sessions resulting in knowledge exchange are described in detail in Section 3.

This peer learning is one of the key offshoots of this project that will continue beyond the project cycle and will be anchored through partnerships that share and upscale project lessons continentally. In addition, a project closeout meeting which doubled as a peer exchange and experience sharing meeting with participating and non-participating countries was held in 30 – 31st May 2019 to highlight experiences, lessons and impacts of the project across partners and beyond the project partners.

1.3 Visibility and Communication

Throughout the project period, lessons, outcomes, and impacts were continually shared on both virtual platforms, through social media and the project website, and physically through participation in global and continental forums on environment and low emission development. Results from this project were used to make an informed case to ministers on environmental actions and to endorse policy positions towards premising environment as a solution to achieve socioeconomic growth. Project results were used to inform ministerial positions towards the adoption of a high-level decision on Innovative Environmental Solutions at the 3rd UN Environment Assembly (UNEA 3) in December 2017 and adoption of decisions to implement climate action as an accelerator of socioeconomic transformation in Africa at the 7th Special Session of the African Ministerial Conference on the Environment (AMCEN) in September 2018. These decisions provide high-level political endorsement for countries to invest in low emissions development pathways. In addition, lessons were shared at a continental multi stakeholder conference on low emissions development – the 2018 African Carbon Forum in April 2018.

Most recently, the Africa LEDS Project close-out meeting and peer exchange event held in Accra, Ghana from May 30 to 31, 2019 provided another opportunity to share results, outcomes, and impacts from the 7 countries with one another, as well as other non-partner countries - specifically Nigeria, Benin, Uganda and Togo. This event concluded with the adoption of a declaration: *The Accra Action Agenda on Low Emissions Development Strategies (LEDS) for Africa*, which urges actors across the continent to adopt the lessons and outcomes of the Africa LEDS project to drive low emission development. The proceedings were widely published in online outlets of regional repute with a continental following.

1.4 Snapshot Achievements by Component

Component 1:

- **Cameroon**: over 500 women for the first time, have access to value addition. They can dry their cassava to increase its shelf life. They can process it into flour that fetches up to five times more in the markets. Through this drying and milling, cassava spoilage has been reduced by up to 30%. On the environmental aspect, the micro-hydro plant generates an annual 9,000 kWh of zero emission electricity relative to the BAU of using diesel generators. Using clean energy over diesel and linking cassava from farm to processing created 150% more jobs and $1,800 in additional revenue compared to the BAU approach.
- **Côte d'Ivoire**: communities can use 6 - 40% less fuel and save a portion of their household incomes when they substitute charcoal and firewood with the rice husk briquettes. Use of the climate smart

rice cultivation practices, including organic fertiliser produced from agro-waste (rice straw and manure), are affordable and accessible, and can more than double rice yields. Further, climate smart rice cultivation implemented along with rice husk briquette production will reduce local forest degradation due to lower demands for charcoal.

- **DRC**: using briquettes has proved up to 3 times cheaper than the conventional charcoal. The country, with this practical LEDS move, can save up to 5,000 ha of natural forest if the paradigm of waste to briquettes is scaled up to the national level.

Component 2:

- **Mozambique**: Mozambique will sequester 70% more carbon by combining improved agroforestry practices with solar powered irrigation relative to a BAU approach of expanding conventional fossil powered irrigation and slash and burn farming. The combination of agroforestry improvements with solar powered irrigation records up to 2 times higher returns / profitability of affiliated enterprises.
- **Ghana:** combining plantation forest with clean cookstoves would sequester 85% more carbon than BAU practices. On the economic front, this combination is expected to generate over 6 million direct jobs and cumulative revenues of over $130 million up to 2030. On the social front, the adoption of clean cookstoves and its reduction of indoor pollution was projected to reduce deaths by over 1,400 per year by 2030.
- **Cameroon:** forecasts show that upscaling and replicating the NDCs implementation trajectory of greening and maximizing productivity of agro-value chains using nature-based agriculture; clean energy; and Information and Communication Technology (ICT) over the country's 5 agro-ecological zones will create 5 million more assorted jobs across multiple sectors relative to BAU approaches and result in 8 times lower emissions.
- **Côte d'Ivoire:** models showed that upscaling the trajectory of improvements to the rice value chain through improved cultivation practices and the utilization of rice mill waste as an energy source would: reduce chemical fertilizer use, reduce rice straw burning, increase rice yields, reduce deforestation (driven by charcoal/firewood harvests), and reduce emissions. For each 150 ha of conversion to the improved rice value chain, the following annual benefits were modelled: 14 tons of chemical nitrogen avoided; 312 tons of rice straw burning avoided; 656 tCO_2e avoided. Also, the rice husk briquette energy attributable to these 150 hectares would protect 18 ha of forest from degradation. Overall, implementation of these improvements to the rice value chain would result in a cost savings to society (1.7 billion CFA through 2050 or about 2.9 million USD). Macroeconomic indicators showed strong potential for positive impacts on local gross regional product (mainly through a combination of avoided chemical fertilizer and fuel purchases and the need for additional labour to support the composting and briquetting processes).
- **DRC:** the model showed that a shift to biogas and briquette cookstoves over BAU use of charcoal, firewood and kerosene would have environmental, social and financial benefits. Environmentally, such a shift would preserve forests - an area of about 0.2 ha/cookstove each year. Socially, this shift

would reduce indoor pollution to cut illness days by 0.52 days. Economically, at the household level, this shift would save up to 56% in average energy costs.

- **Kenya:** forecasts show that investing in clean cookstoves and agroforestry will result in 2.9 million tons of charcoal saved annually which equates to approx. $1 billion by 2030.
- **Zambia:** forecasts show that investing in assisted natural regeneration where clean cookstoves minimise deforestation to enhance regeneration and solar and micro-hydro mini-grids will add up to $15 million into gross domestic product (GDP). Sustainable agriculture eliminating mineral fertiliser will result in an emissions reduction of up to 0.91 Gg by 2030.

Component 3:

Peer learning and lessons exchanges: a peer exchange platform called the AFOLU Community of Practice (AFOLU CoP) has been established to ensure project lessons and experiences are shared continentally through a network of regional institutions and partner activities. As a key highlight of the CoP, Mozambique became a peer advisor to a team from Ghana on adapting the REDD Abacus model to run agroforestry project level scenarios and to link with the LEAP model to provide an integrated picture of impacts across sectors. Building on this collaboration, the Eduardo Mondlane University, which served as the technical lead in Mozambique under the project, was appointed as an Africa LEDS Project peer learning champion in May 2019 and is implementing peer learning activities. At the project close-out meeting, results were shared with non-participating countries, Benin, Nigeria, Togo and Uganda. As a result, state and non-state stakeholders from these countries called for replication of lessons across Africa. This meeting culminated to adoption and endorsement of a ground-breaking declaration, "the Accra Action Agenda on Low Emissions Development Strategies (LEDS) For Africa". This declaration, which urges governments across Africa to create an enabling environment for investments in low emission development as demonstrated by the Africa LEDS Project, is set for presentation to ministers at the upcoming 17th ordinary session of the Africa Ministerial Conference on the Environment (AMCEN). This will give project results high-level policy endorsement for continent-wide upscaling.

The following table summarizes analytic results and opportunities for national scale-up.

1.5 Summary of Analytic Results and Opportunities for Scale-up

Country	Key Institutions Engaged	Analytic Tools	Socio-Economic and Cost Impacts Associated with Actions	Environmental Impacts Associated with Actions	Other Impacts	Scale-up Opportunities
Cameroon	Ministry of the Environment, Nature Protection and Sustainable Development, Ministry of Forests and Wildlife, National Observatory on Climate Change, Sub-department of Ecological and Climate Modelling (SDMESC), Action for an Equitable, Integrated and Sustainable Development NGO (ADEID), University of Yaoundé, Jakiri Co-operative Ministry of Telecommunication, University of	Customised dynamic Model developed by modelling team (mathematicians and computer scientists) from University of Yaoundé	**Impacts projected by modelling runs** 1) Achieving national target of 50 million tonnes of cassava using Transformative LEDS approach, combining approach, combining nature-based agroforestry at farm level and integrates clean energy for processing, and ICT for digital marketing showed clear benefits over BAU focusing on farm level cultivation alone without value addition and using traditional cultivation approaches. - BAU scenario will create about 8 million jobs cumulatively in 10 years up to 2028 and contribute 0.006% of GDP per year. The transformative LEDS approach will create 13 million jobs cumulatively in the same period and contribute about 0.56% of	**Impacts projected by modelling runs** 1) Using BAU approach to generate 50 million tonnes of cassava would requires over 3 million Ha of land. Using transformative LEDS approach demonstrated by this project would require about 1.4 million ha, saving 1.6 million ha of forest sinks that would otherwise be cultivated on hence lost under BAU approaches. 2) Greening the cassava agro-value chain covering up to 130,000 ha can mitigate 1.7 million tCO_2e, a 2.3% mitigation of Cameroon's GHG emissions. **Pilot project impacts or projected impacts –** 1) Carbon footprint of cassava product transportation was lowered	1) 70 Jakiri cooperative members using agroforestry 2) 40 youths and 20 professionals trained in agri-tech business practices 3) 35 professionals trained in clean energy enterprise practices	1) Opportunity to green the agro-value chain of 130,000 ha of Cassava throughout Cameroon using nature based organic approaches at the farm level, clean energy in processing and ICT digital marketing tools for connection to markets. 2) 4,200 ha available for scale up in Ngoulmakong in particular 3) Policy level uptake of this integrated

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	Dschang, TKSWIFT (Afroshop creators)		GDP each year. This is 5 million more jobs if government invests to maximise Cameroon's cassava value chains using the transformative LEDS approach demonstrated by the project. 2) The government indicated it plans to invest in 130,000 ha of cassava by 2035 and wanted to establish the long-term impact of this decision if implemented using the transformative LEDS approach. - Model shows implementing this decision using the transformative LEDS approach demonstrated by this project would cumulatively create 5.2 million jobs with USD $3.7 billion revenue between now and 2035. This is about 325,00 jobs per year. 3) Integration of ICTs to link producers using the climate resilient approaches	from 1,269 tCO_2e BAU to 821 tCO_2e when the Afroshop digital marketing tool was integrated to complement marketing efforts and reduce physical travelling by fossil powered vehicles. The distance covered by fossil powered vehicles reduced from 22 km per tonne to 4 km per tonne. Afroshop eliminated need to physically travel to market wares as they are instead posted online. 2) In drying 750 tonnes of cassava, replacing firewood powered cassava drier with solar powered driers saved 14 tonnes of firewood and sequestered an estimated 98 tons of CO_2 produced by firewood driers annually		approach to greening Cameroon's agro-value chains as part of national strategy for economic growth, job creation and NDCs implementation 4) Integrated approach to greening agro-value chains demonstrated in Jakiri and Ngoulemakong developed into a "model of green villages" and adopted by the Jakiri and Ngoulemakong municipal councils. Ten additional councils in the

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			to markets– at the upstream for efficient access to inputs information and downstream digital marketing for efficient market information – would maximise return on investment to 10.3% vis-à-vis 6.3% for LEDS only and 8.4% for BAU. **Pilot project impacts or projected impacts** – 1) 25% increase in cassava yield as a result of integrating agroforestry, using improved cassava varieties and enhanced management of actions using SAPGA; 2) 35 jobs created by agroforestry and apiculture demonstration project; Replacement of diesel-powered mills with the micro-hydro results in 67% ($2,230) annual energy cost savings;			Adamaoua region developing a “digitized green village Cameroon” for their greening activities based on the project demonstration. 5) Afroshop model to integrate blockchain for credit control / cooperative loan evaluation of majority of agro-value chain actors who do not keep regular transaction records hence cannot be absorbed optimally into cooperatives structure

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			3) Use of micro-hydro meshed to electric motors results in a 93% increase in cassava flour throughput relative to the diesel-powered mills; 4) The integrated approach from on-farm using agroforestry to processing powered by clean energy and packaging and ICT digital marketing created 150% more job opportunities and $1,800 additional revenue relative to the BAU approach using traditional cultivation and fossil powered generators. 5) The Jakiri Cooperative demonstrated that combination of agroforestry and improved cassava varieties, apiculture, clean energy processing of cassava and ICT for precision application of nature-based agriculture			

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			(SAPGA) and ICT enabled linkages of cassava and honey to markets (AfroShop) resulted in sales of $91,500 against investment costs of $76,700. This is a profit of $15,000 for 500 tonnes of cassava processed into 150 tonnes of flour. A BAU scenario of terminating at on-farm production would yield lower sales of $29,400 against investments of up to $52,000 – meaning a potential loss of $22,600. 6) Use of AfroShop digital marketing software increased sales by 259%, a record for the Jakiri Cooperative. It also reduced transport costs from $18.76 per tonne in BAU approach where no digital marketing tools are used to connect to markets,			

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			to $12.50 per tonne – resulting in savings of $6.26 per tonne – 33% in savings. 7) Shifting to micro-hydro power saves farmers 25-45% of budget in processing cassava. 8) Use of ICT enabled, precision on-farm management of cassava through the SAPGA for precision follow-up in watering, planting and application of organic biofertilizer resulted in reduction of farm-level losses to 10% from a high of 25%			

Country	Key Institutions Engaged	Analytic Tools	Socio-Economic and Cost Impacts Associated with Actions	Environmental Impacts Associated with Actions	Other Impacts	Scale-up Opportunities
Côte d'Ivoire	National Commission on Climate of Côte d'Ivoire, National Office of Technical Studies and Development, Office of Parks and Recreation, Directorate of Strategy, Planning and Statistics, Union of Cities and Municipalities of Côte d'Ivoire (UVICOCI), Ministries of Planning and Development, Petrol, Energy, Renewable Energy Promotion, Forests, Animal Resources and Fisheries, Agriculture and Rural Development, Rural Engineering Unit, Climate Change Division, Development	LEAP – IBC, EX-ACT, CCS LEDS toolkit, Geographic information system (GIS)	1) $4,713 additional revenue for annual production of 17,280 kg rice briquettes per year by the rice mill owner 2) Compost in place of mineral fertilizer saves $50,000 per year for 150 ha of rice production 3) 150.5 ha of rice irrigated with improved rice production techniques has average yield of 4.3 tons/ha compared to BAU 2.9 tons/ha 4) Briquetting operation offers capacity to stimulate 2-3 indirect jobs per plant through demand for inputs, offsetting displacements in charcoal and kerosene 5) Lower final cost of energy to end user of briquettes frees up spending power for other needs	**Pilot Program:** 1) Introduction of rice husk briquettes: >2,500 tCO_2e reduction through 2050 2) Improved pilot scale rice production system results in reduction of 15,288 tCO_2e compared to BAU through 2050; a reduction of 453 metric tons of nitrogen fertilizer are also avoided; 10,000 metric tons of rice straw are composted rather than burned 3) Implementing both Pilot Projects together would sequester 2,069 tons of carbon through 2050 and would protect 18 ha of forest from degradation/ deforestation; reduce >20,000 tCO_2e through 2050	1) 93 farmers trained in intelligent farming practice and biofertilizer production 2) 2 water management committees formed **Pilot 1:** Provided lessons-learned to promote national scale-up of rice husk briquette production for small rice mill operators (< 2 tons/day of paddy rice), including the importance of national/international assistance on the up-front costs of briquetting process equipment (husk carbonizer and briquette press), local market support (availability of	1) Improved rice production techniques could be scaled up at a national level within 100,000 ha of rice paddy farms 2) With 100,000 ha of rice paddy farms turning rice waste into biofertilizer, 16,000 jobs would be created for improved rice cultivation; an additional 1,300 jobs would be added at rice mills for bio-briquette production 3) Through 2050, 149 terajoule reduction of kerosene/ charcoal energy use compared to BAU

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	Research Division, Association of Regions and Districts of the Côte d'Ivoire, National Coordinator of Cereal Subsidies, General Confederation of Enterprises of Côte d'Ivoire (CGECI), AINER, GIWA, Amistad, JVE Côte d'Ivoire, IREN, University Center for Research and Analysis in Remote Sensing, University of Nanguo Abrogoua, National Center for Agricultural Research, Ivorian CentFer for Economic and Social Research (CIRES), EREADO		6) Sourcing of briquetting equipment through foreign donation/investment represents opportunity for overall economic stimulus, as productivity gains do not require diversion of local funds to be achieved 7) Early results from the field in pilot 2 indicate a potential for more than doubling rice yield from SRI	4) 224 giga-joules of kerosene cooking fuel offset each year by introducing rice husk briquettes into local markets 5) Early results from the field in pilot 2 indicate a 90% reduction in the use of chemical fertilizers; a 100% reduction in crop residue burning; and a greater than 50% reduction in the number of rice seedlings required	improved cookstoves optimized for briquettes; and local marketing of the improved qualities of briquettes versus charcoal); **Pilot 2:** Trained 87 rice growers and other professionals in: (1) water management infrastructure; (2) sustainable agricultural practices; and (3) production of biofertilizer from rice straws. **Both Pilots:** Capacity built within a local team to further analyze and report on a broader sustainable cooking strategy for the country, including	if both pilots are scaled to 100,000 Ha of rice production, as well as >300,000 tons of chemical nitrogen fertilizer 4) Through 2050, >13 million tCO_2e reduced if scaled to 100,000 Ha of rice production 5) Scaled to 100,000 ha of rice production, nearly 12,000 ha of forest would be protected from degradation/ deforestation

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					GHG reductions in the Agriculture sector (methane emissions during rice cultivation, GHGs from rice straw burning), Energy sector (GHGs from liquefied petroleum gas or wood/charcoal combustion), and FOLU sector (carbon dioxide from unsustainable biomass harvests). **For Component 2:** - Built a customized integrated modelling framework to assist in determining the best scenarios for low carbon actions. - Built local capacity to assess the overall environmental and	

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					socioeconomic benefits/costs of single and integrating scenarios. - Identified key needs for NDC policy development and implementation: financing needs for local mill operators; re-training and job placement for forest biomass fuels producers; marketing of bio-briquettes (demonstrations and cooking stove programs).	

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Democratic Republic of the Congo	Department of Sustainable Development, Ministries of Agriculture, Energy and Hydraulic Resources, Land Forests, Environment, Transport, Finance, and Planning, Petroleum, Industry, Higher Institute of Applied Technologies, Center for Study and Research in Renewable Energy, University of Kinshasa, Center for Integrated Rural Development and Adaption, Center for Adaptation to Climate Change and Integrated Rural Development, BIODEC NGO,	MEAD	1) Improved cookstove scale up could reduce charcoal consumption by 5.8 kg/week for an average household. 2) Improved cookstove scale up could reduce charcoal use by 15 million kg from BAU. 3) Briquettes provide 70% more energy than traditional charcoal, providing an energy efficiency benefit. 4) 25,000 jobs could be created by 2050 to support improved cookstove production. 5) Improved cookstoves save up to 62% of wood and 62% of cost relative to BAU firewood and charcoal. 6) Improved cookstoves generate fuel savings that	1) 5,000 ha of natural forest could be saved with improved cookstove introduction. 2) 277 tCO_2e could be avoided annually with Kinshasa biogas production unit (by saving forests/carbon sink).		Opportunity for significant scale-up of cookstove program.

Country	Key Institutions Engaged	Analytic Tools	Socio-Economic and Cost Impacts Associated with Actions	Environmental Impacts Associated with Actions	Other Impacts	Scale-up Opportunities
	Carbon Map and Model Project, University of Kwango, Central Bank of Congo, National Institute of Statistics		can equate to more than ten times their purchase price.			
Ghana	Energy Commission, Environmental Protection Agency, Centre for Energy and Climate Policy, University of Ghana, Ministry of Food and Agriculture, Forestry Commission, University of Development Studies, Ghana Statistical Service, National Development Planning Commission	LEAP, REDD Abacus and linkage across the two	1) Total cost of improved cookstove strategy will be 39% less than scale up of traditional cookstoves. 2) 9,266 stove manufacturing jobs could be created. 3) Converting designated open forests to wood-fuel plantation could save $1,383 million monetary equivalents for 2016-2030. 4) Scaling up adoption of clean cookstoves will reduce indoor pollution and projected to reduce deaths. by over 1,400 per year by 2030.	1) Improved cookstoves could reduce carbon emissions by 50% by 2030 compared to BAU. 2) Combining to wood-fuel plantation forest / renewable forests with clean cookstoves will sequester 85% more carbon than focusing on improved cookstoves alone and convert 12,000ha of degraded area into wood plantation every year. 3) 17.7 million tCO_2e could be mitigated if 2,256,000 tons of renewable biomass is	Approximately 30,000 avoided deaths in improved cookstove.	Significant opportunities to scale up cookstoves and agroforestry. At policy level, model providing the government an objective basis to expand on its policy of incentivising investment in clean cookstoves, to also include complementing cookstoves with renewable forest plantations to

Country	Key Institutions Engaged	Analytic Tools	Socio-Economic and Cost Impacts Associated with Actions	Environmental Impacts Associated with Actions	Other Impacts	Scale-up Opportunities
			5) Land conversion to wood-fuel plantations could create 3,628,800 jobs. 6) Manufacture of improved cookstoves and establishment of wood fuel plantation projected to create 6,459,266 direct jobs cumulative by 2030. 7) $9 million annual average investment revenues from the combination of wood-fuel plantation projects and improved cookstove technology.	burned in 14 million improved cookstoves. Where harvested areas are replanted to accelerate reforestation, and harvesting done according to sustainable management plans. This is relative to BAU use of traditional stoves and allowing natural regeneration of harvested forest areas 4) 59.75 million tCO_2e reduction potential when linking wood-fuel plantation impacts and improved cookstove actions by 2030.		maximise both climate and socioeconomic benefit.
Kenya	Ministry of Environment and Forestry, Ministry of Energy, Climate Change Directorate, Ministry of Finance, Kenya Forest Service, Jomo Kenyatta University of	LEAP, Abacus, I-JEDI	1) Modern stoves could reduce household fuel expenditures by 23% 2.9 million tons of charcoal saved annually (with improved cookstoves) equates to 165 billion Kenyan shillings (approx. $1billion) by 2030.	1) 7 million tCO_2e reduction by 2030 with combined scenario including both adoption of energy efficient stoves and transition to liquefied petroleum gas (LPG) and other clean fuels.	Estimated 850 premature deaths due to indoor air pollution could be avoided annually by 2030 by shifting to clean domestic cooking.	Potential area of 5,854,613 ha of agriculture land that could have combined agroforestry and cookstove interventions.

Country	Key Institutions Engaged	Analytic Tools	Socio-Economic and Cost Impacts Associated with Actions	Environmental Impacts Associated with Actions	Other Impacts	Scale-up Opportunities
	Agriculture and Technology, Department of Remote Sensing and Resources Survey, Kenya Forest Research Institute, NREL, Stockholm Environmental Institute		2) 6.8 million tons of firewood saved with combined scenario. 3) Moving from firewood/charcoal stove to clean cooking in Kajiado county adds $253,490 of value to GDP. 4) Implementation of the 2009 agroforestry rules would result in a net economic benefit of approximately $9.6 billion in the next 30 years.	2) Implementing 2009 farm forest rule could abate 434 million tCO_2e by 2044 (next 25 years). 3) Emissions reduced from 132 million tCO_2e to 95 million tCO_2e in 30 years if tree cover is increased by 10% in areas currently used for slash-burn practices.		
Mozambique	Ministry of Land, Air and Rural Development (MITADER), Eduardo Mondlane University, National Institute of Irrigation Statistics, Mozambique Institute of Agricultural Research (IIAM), National Irrigation	REDD Abacus and LEAP	1) Net present cost for fuel powered irrigation (FPI) is $62,494, net present cost for solar powered irrigation. (SPI) is $16,472, providing a significant savings. 2) Job creation could double under SPI as compared to FPI. 3) Net present value of agroforestry (AFS) is $233-	1) Replacing fuel powered irrigation (FPI) with solar powered irrigation (SPI) reduces average. annual tCO_2e by 3,643 $tC0_2e$. 2) Replacing slash and burn agriculture (SAB) with agroforestry (AFS) results in 33% reduction in average annual net emission (4 million $tC0_2e$ annually).	Results from LEDS project have informed prioritization of agriculture powered by renewable energy as key area for lowering emissions. This is captured in NDC commitment revisions.	1) Scale up agroforestry to over 4,000,000 ha. 2) Could scale up SPI to reach 90,000 ha. 3) Over 23 TW of renewable energy potential to support SPI. 4) At policy level, the National

Country	Key Institutions Engaged	Analytic Tools	Socio-Economic and Cost Impacts Associated with Actions	Environmental Impacts Associated with Actions	Other Impacts	Scale-up Opportunities
	Institute (INIR), ASCUT		309/ha, BAU slash and burn (SAB) is $130/ha. 4) AFS is the only land use system studied that generates high profits, high jobs, and medium carbon stocks. The highest net present value of $450 per acre is registered by converting natural forests to agroforestry nationally. 5) Policy upscaling investment in the combination of agroforestry with solar powered irrigation would maximize all important parameters of climate action and development. Profitability of enterprises will be up to 2 times higher.	3) A combined approach (SPI + AFS) has the potential to lower cumulative GHG emissions to 1.9 million tCO_2e annually (compared to 6 million $tC0_2e$ BAU). 4) Mozambique will sequester 70% more carbon through a policy upscaling investment in combining agroforestry improvements with solar powered irrigation relative to a BAU approach of expanding conventional fossil powered irrigation and slash and burn farming. 5) Linking SPI and AFS responsible for 54% emission reduction from irrigation and land use change. 6) 65% of emissions from land use change processes is from SAB, so		Irrigation Institute under the Ministry of Agriculture and Food Security is preparing proposals to scale out solar powered irrigation across Mozambique based on the modelling results. 5) Project results informing NDCs revisions to prioritise AFS and SPI as key activities for emission reduction, and socioeconomic benefit. 6) Project results informing Biennial Update Report (BUR) and National Communication (NC) for NDCs on

Country	Key Institutions Engaged	Analytic Tools	Socio-Economic and Cost Impacts Associated with Actions	Environmental Impacts Associated with Actions	Other Impacts	Scale-up Opportunities
				replacement of SAB with AFS has large potential impact.		emissions and emission reduction potential. 7) Project has revealed gaps in systematic data needs for policy decision making and set to inform national institutions – the National Irrigation Board (INIR), and the Agricultural Research Institute of Mozambique (IIAM) next steps in systematic data collection and providing a platform for seamless data access.
Zambia	Ministries: National Development Planning, Local Government, Health,	LEAP, I-JEDI, DIA (Development Impact	1) $15,863,018 added to GDP from investing in sustainable agriculture in three project areas	1) 1.11Gg CO2e reduction in GHGs from implementing sustainable		1) Significant opportunities to scale up sustainable

Country	Key Institutions Engaged	Analytic Tools	Socio-Economic and Cost Impacts Associated with Actions	Environmental Impacts Associated with Actions	Other Impacts	Scale-up Opportunities
	Energy, Agriculture, Environment, Natural Resources, Communications, Minerals Development, Information and Broadcasting, Works and Supply, Home Affairs, Disaster Management and mitigation, Gender, Transport and Communication, Center for Energy, Environment, and Engineering, MLNR-CCNRMD, Zambia Institute for Policy Analysis and Research (ZIPAR), University of Zambia, Zambia Environmental Agency, EMD, Zambia	Assessment), AFOLU Analysis Tool	2) 6,824 jobs created from investing in sustainable agriculture in the three project areas 3) 84 jobs could be created by forest enhancement and natural regeneration project in a single year (negative jobs in following years) 4) Installing three mini hydro and 2 PV projects would create 1,625 construction jobs and 159.7 operation and maintenance jobs 5) Positive impact on quality of indoor air due to reduction in cooking emissions 6) Reduction in incidences of respiratory problems as a result of improved household air 7) Time spent collecting firewood reduced	agriculture in three project areas in 2020 2) Energy demand in BAU is 709,000 GJ in 2030, under the improved cookstove scenario energy demand is 53,000 GJ		agricultures, small scale RE and cookstoves 2) At policy level, results reported to policy makers at Steering Committee and Council of Ministers as provided for in the Zambia National Policy on Climate Change of 2016.

Country	Key Institutions Engaged	Analytic Tools	Socio-Economic and Cost Impacts Associated with Actions	Environmental Impacts Associated with Actions	Other Impacts	Scale-up Opportunities
	Meteorological Department		8) Women and children benefit from reduced time preparing meals and collecting firewood 9) Improved local climate due to reduction in smoke emissions 10) Positive impact on food security due to controlled or reduced harvest of trees allowing more forest output			

2. Actual Results

The following table summarizes accomplishments of the project in alignment with the project log frame.

Project Component	Project Outputs	Indicators	Means of Verification	Progress Made/Results Achieved
Component 1: LEDS planning and implementation support	LEDS initiatives developed or improved	3 partner countries (Cameroon, DRC, Côte d'Ivoire) develop or improve LEDS plans	LEDS plans prepared by the countries	**Cameroon**: demonstration actions finalised, sites operationalised, and case studies based on demonstration actions finalised. Case studies shared with policy actors at national and sub-national level have resulted in development of LEDS plans as follows: **a)** At the sub-national level, the "digitalized green villages of Cameroon" to green agro-value chains in Jakiri and Ngoulemakong municipalities and 10 other councils in the Adamaoua region. **b)** At national level, the case study results have been handed over to policy team drawn from environment, agriculture, and energy ministries. Team developed policy recommendations to integrate case study findings into future LEDS investments to ensure they maximize both climate and socio-economic benefits of NDCs implementation. **Côte d'Ivoire**: ground demonstration actions of converting rice straw waste to biofertilizer and rice husk waste to fuel briquettes was completed, and case studies developed from project results. These studies are informing national low emissions development plans in the agriculture, forestry, and energy sectors as follows: **a)** Agriculture: case study findings informing revisions and upgrading of the national climate smart agriculture strategy, also case studies inform implementation actions for the national strategy of efficient recovery of waste towards circular economy through creation of a "green SME's cluster". These provide best practice of practical approaches for conversion of agricultural waste to energy (briquettes) and biofertilizer.

Project Component	Project Outputs	Indicators	Means of Verification	Progress Made/Results Achieved
				b) Forestry: case study findings informing development of the sustainable cooking energy strategy to strengthen Côte d'Ivoire's reducing emissions from deforestation and degradation (REDD+) mechanism. **c)** Energy: case study findings informing national framework for incentivising private investment in sustainable cooking energy options. **DRC**: ground demonstration projects on waste to energy (organic waste to biogas and general solid waste to fuel briquettes) for the replacement and use reduction of wood fuel completed and lessons from the demonstration project compiled into a case-study: a) Case studies informed waste management strategy of the Municipal Administration of Gombe and the Sanitation Authority of Kinshasa (RASKIN) forming two management levels: a structure for production of briquettes and a network of autonomous waste collectors and a sorting unit for recovery. b) results of ground demonstration actions inform adoption of 3 guidelines for scaling up waste to domestic energy nationally; - guidelines for better management of wood energy supply sources; - guidelines for the promotion of alternative efficient domestic energy sources (briquettes and biogas); and - guidelines for the promotion of efficient cooking equipment (e.g. improved cook stoves) in academic institutions e.g. boarding schools, hospitals, and eateries. The inter-ministerial consultative technical forum for the domestic energy sector established by the project was the lead in transmitting lessons for adoption by policy actors.

Project Component	Project Outputs	Indicators	Means of Verification	Progress Made/Results Achieved
	Implementation of specific LEDS measures initiated	3 partner countries initiate formulation and implementation of LEDS measures for key emissions sectors or economy wide	National and sectoral policy documents and plans and progress reports	Inter-ministerial policy teams established in Cameroon, Côte d'Ivoire and DRC to lead in infusing project lessons into policy planning. These teams coordinated development of case-studies from the ground demonstrations that summarised key lessons to infuse into policy structures. - Cameroon: the inter-ministerial task force worked with municipal governments to inform development of the "digitalized green villages of Cameroon" that will implement the demonstrated LEDS action of greening agro-value chains using nature-based approaches, clean energy, and ICT in 12 municipalities. - Côte d'Ivoire: the inter-ministerial task force infusing project lessons documented in case studies into national low emissions development plans in agriculture, forestry and energy sectors. - DRC: the inter-ministerial task force working with subnational government to infuse project lessons into waste management strategy of the Municipal Administration of Gombe and the Sanitation Authority of Kinshasa (RASKIN).
	Enhanced global and regional knowledge of LEDS planning and implementation	At least 5 non-partner African countries actively participating in peer forums More than 1 non-partner country formulating	Survey to collect feedback from countries on use of knowledge and capacity to help strengthen	- Project Component 1 lessons inform deliberations by the Africa Group towards adoption of high-level policy decisions on investing in innovative environmental solutions for the implementation of the Paris Agreement and the SDGs at the UN Environment Assembly (UNEA). They also inform African Ministers of the Environment towards adoption of similar decision at the Africa Ministerial Conference on the Environment (AMCEN) – which has all 54 African countries as member states. Meaning project lessons on optimal LEDS implementation taken up at global and regional levels.

Project Component	Project Outputs	Indicators	Means of Verification	Progress Made/Results Achieved
		LEDS plans based on shared project knowledge Non-partner countries develop and implement LEDS measures based on shared project knowledge	their LEDS and intended nationally determined contributions LEDS plans developed by non-partner states LEDS shared by non-partner countries	- Project closeout meeting and experience sharing forum concluded with adoption of the “Accra Action Agenda on Low Emissions Development Strategies (LEDS) For Africa” decision which calls for countries across Africa to invest in low emissions strategies demonstrated by the project. Nigeria, Benin, Togo and Uganda were the non-partner country actors who called for and endorsed this decision – Website visible to global audience and continuously updated with country-level implementation progress. – Twitter account engaged to promote project progress and update global audience including non-partner countries on project implementation progress, experiences and lessons. – Project engaged in third party continental events to share innovative approach of maximizing both the climate and socioeconomic impacts of the implementation of NDCs – the African Carbon Forum. – CoP established and sharing project novel approaches to NDC implementation maximizing both climate and socioeconomic aims with stakeholders across the continent.

Project Component	Project Outputs	Indicators	Means of Verification	Progress Made/Results Achieved
	LEDS champions cultivated	At least 3 institutions identified as LEDS champions to lead LEDS and implement peer-learning efforts LEDS training and equipping of identified champions Partnerships formed between champions to facilitate peer-learning	Written communication from champions on their engagement leading the peer-learning efforts Peer-learning efforts reports Active participation of champions in the LEDS online knowledge exchange platform	- Communities of Practice (CoP) provided a platform to cultivate champion institutions through online knowledge exchanges via the Africa LEDS project webinar knowledge exchanges. - Mozambique Eduardo Mondlane University appointed as peer learning champion for the project based on leadership throughout the project. - Engagement of 3 champion institutions for remote learning on lessons from Africa LEDS work through the CoP - CEEEZ Zambia on I-JEDI, Mozambique Eduardo Mondlane University on solar water pumps, and Côte d'Ivoire Ministry of Environment on rice husk briquette activities
Component 2: LEDS modelling support	LEDS actions prioritization and decision-maker support for priority LEDS measures	Priority LEDS actions identified for 8 partner countries At least 8 countries with strengthened	Results of the prioritization incorporated on LEDS or the implementation plan	– All project partner countries supported to develop and implement analytical modelling tools to inform optimal NDCs investment trajectories that maximize both climate and socioeconomic priorities. Models run to inform sectorial priorities to be integrated into policy, plans and strategies as follows; **Country-specific details:** - **Cameroon:** model runs validated using Component 1 ground data, forecast that using nature based on-farm approaches, clean energy and ICT to drive achievement of the

Project Component	Project Outputs	Indicators	Means of Verification	Progress Made/Results Achieved
	significantly enabled	LEDS process as a result of the prioritization process		strategic government priority of increasing cassava coverage to 130,000 ha or producing 50 million tonnes of cassava would provide 5million more jobs and save up to 1.6 million ha of forest sinks and mitigate up to 1.7 million tCO_2 relative to a BAU scenario. This is 8 times lower emissions than the BAU approach by 2035. - This analysis provided decision makers with a concrete measure of the impact of a “greening and digitization” policy at national level and at subnational level were 12 municipalities are set to replicate this paradigm. **- DRC:** model runs forecast that the country can save up to 5000 ha of natural forest per year if the paradigm of waste to briquettes is scaled out and replicated nationally. Socially, this would reduce indoor pollution to cut illness days by 0.52 days. Economically, models show that at the household level, this shift would save up to 56% in average energy costs. At the economy-wide scale, the model showed that DRC would create no less than 22,800 jobs each year along the biogas and improved cookstoves and briquettes value chains – which is just 8,000 jobs shy of what is targeted by the entire economy by 2050. - This analysis is providing decision makers with actionable information to optimally invest in government programmes of; **a)** increasing the contribution of renewable energies in the energy mix; **b)** promoting the use of modern biomass, and **c)** the production and distribution of clean cookstoves to substitute unclean cooking facilities in at least 1 million homes with at least 50% being in the urban and semi-urban where demand for charcoal is high. **- Côte d’Ivoire:** model runs were conducted to investigate the costs and benefits for implementing each pilot separately and together. Modelling the scale-up to the national

Project Component	Project Outputs	Indicators	Means of Verification	Progress Made/Results Achieved
				level of improvements to the rice value chain indicates that ~3.3 million tCO_2e could be reduced annually (based on an estimate of ~5,000 small rice mills operating within the country). This could protect 90,000 ha of forest from degradation/deforestation. - Côte d'Ivoire – model runs forecast that: **a)** communities can use 6 - 40% less fuel and save their household incomes when they substitute charcoal and firewood with the briquettes. **b)** upscaling the trajectory of agricultural waste to domestic energy and biofertilizer, would reduce deforestation driven by charcoal and firewood harvesting on the BAU trajectory by 50% **c)** use of biofertilizer from rice straw waste instead of BAU scenario of using mineral fertilizer avoid 453 tonnes of nitrogen in chemical fertilisers. **d)** use of the organic fertiliser produced from agro-waste, was not only affordable and accessible, but also resulted in a 35 - 100% increase in yields (in combination with other cultivation improvements). Organic fertiliser over mineral fertiliser would save over $300 per ha each year. **e)** net savings from shifting from BAU mineral fertiliser, charcoal / firewood and open dumping / burning of agriculture waste to transformative approaches of converting waste to biofertilizer and fuel briquettes results in national level net savings of approx. CFA 1.7 billion ($2.1 million) by 2050. The above analysis is informing decision-making in implementing the following LEDS plan:

Project Component	Project Outputs	Indicators	Means of Verification	Progress Made/Results Achieved
				- the National Agricultural Investment Plans (NAIP) with strategies to limit deforestation (REDD+ process). **- Mozambique:** model runs forecast that achieving the government's national objective of increasing irrigated land to 90,000 ha by 2020 and maintain the same rate up to 2030 will have following results: **a)** Mozambique will sequester 70% more carbon by amalgamating agroforestry and solar powered irrigation relative to a BAU approach of expanding conventional fossil powered irrigation and slash and burn farming. **b)** A partial approach replacing 50% BAU slash and burn with agroforestry will sequester 33% more carbon by the 2030's. **c)** BAU fossil powered irrigation will escalate emissions to over 6times higher by 2030 relative to the transformative approach of solar powered irrigation. **d)** On the socioeconomic front, the highest net present value of $450 per acre and highest jobs of 120 days per ha, is registered by converting natural forests to agroforestry. **e)** Fossil powered irrigation will be 3times costlier than the solar powered irrigation. **f)** Solar powered irrigation will create over 87% more jobs at zero net emissions relative to BAU fossil powered irrigation. **g)** Solar powered irrigation on agroforestry farms will create highest returns of over $250/ha and highest employment of over 1000 days/ha relative to alternative scenarios of solar powered irrigation alone which creates at best $150/ha in profits or BAU of fossil irrigation in slash and burn which creates about $75/ha in profits. The above analysis is informing LEDS planning decision making as follows:

Project Component	Project Outputs	Indicators	Means of Verification	Progress Made/Results Achieved
				- the National Irrigation Institute under the Ministry of Agriculture and Food Security is preparing proposals to scale-out solar powered irrigation across Mozambique based on the modelling results. - Project results informing NDCs revisions to prioritise AFS and SPI as key activities for emission reduction, and socioeconomic benefit. - Project results informing Biennial Update Report (BUR) and National Communication (NC) for NDCs on emissions and emission reduction potential. - Project has revealed gaps in systematic data needs for policy decision making and set to inform national institutions – the National Irrigation Board (INIR), and the Agricultural Research Institute of Mozambique (IIAM) next steps in systematic data collection and providing a platform for seamless data access. - **Kenya:** model runs forecast that: **a)** Modern stoves could reduce household fuel expenditures by 23%. **b)** 2.9 million tons of charcoal saved annually (with improved cookstoves) equates to 165 billion Kenyan shillings (about $1 billion) by 2030. **c)** Emissions could be reduced from 132 million tCO_2e to 95 million tCO_2e in 30 years if tree cover is increased by 10% in areas currently used for slash-burn practices. **d)** 7 million tCO_2e reduction by 2030 is possible with combined scenario of clean cookstoves, LPG and other clean cooking. **e)** implementation of the 2009 agroforestry rules would result in a net economic benefit of approximately 9.6 billion USD in the next 30 years and mitigate an estimated 434 million tonnes CO_2 over the next 25 years.

Project Component	Project Outputs	Indicators	Means of Verification	Progress Made/Results Achieved
				f) implementation of the National Climate Change Action Plan (NCCAP) 2018-2022 agroforestry interventions alone (i.e. absent the proposed 2009 agroforestry rules) would result in an estimated 297 million tonnes CO_2 over that same timeframe. The above analysis is set to inform farm forestry policy, National Climate Change Action Plan, and updates to NDC **- Zambia:** model runs forecast that investing in assisted natural regeneration where clean cookstoves minimise deforestation to enhance regeneration as well as solar and micro-hydro mini-grids will add up to $15 million into GDP. - Sustainable agriculture including eliminating mineral fertiliser will result in emissions reduction of up to 0.91 Gg by 2030. - Total economic impacts of implementing the sustainable agriculture activities including switching from mineral fertiliser to organic fertiliser amount to 6,824 direct, indirect and induced jobs; $8,272,418 in earnings; $15,863,018 in GDP; and $22,205,582 in outputs for Kalomo, Petauke and Mpika districts collectively by 2030. These results were reported to higher level policy makers at Steering Committee and Council of Ministers as provided for in the Zambia National Policy on Climate Change of 2016. Results are informing updates to the NDC and implementation of small-scale renewable energy and forest regeneration projects **- Ghana:** work demonstrated that the NDC priorities in domestic energy, forestry, agriculture and land-use could be maximised for both climate and socioeconomic benefit through a trajectory of clean cookstoves fired by renewable wood. As opposed to more traditional BAU mitigation approaches of focusing only on the clean cookstoves component. Accordingly, Ghana models showed that:

Project Component	Project Outputs	Indicators	Means of Verification	Progress Made/Results Achieved
				a) combining plantation forest with clean cookstoves would sequester 85% more carbon than BAU. **b)** on the economic front, this combination is expected to generate over 6 million direct jobs and cumulative revenues of over $130 million up to 2030 – which is an average of $9 million per year. **c)** On the social front, the adoption of clean cookstoves reducing indoor pollution was projected to reduce deaths by over 1,400 per year by 2030. - at a policy planning level, the above analysis is providing the government an objective basis to expand on its policy of incentivising investment in clean cookstoves, to also include complementing cookstoves with renewable forest plantations to maximise both climate and socioeconomic benefits. - results will also inform updates to the country's NDC and an NDC public outreach strategy with a particular focus on socio-economic benefits (previously not prominently featured in the NDC) and further implementation of a "learning by doing" approach to analysis to enable future / subsequent NDC updates.
	Strengthened analysis and communication of LEDS benefits	At least 8 countries with strengthened stakeholder support for LEDS process as a result of improved analysis and	Evidence of communication products (e.g.., webinars, reports, newsflashes, webpages, policy briefs	- Across the countries, inter-ministerial and modelling teams briefed decision-makers and other stakeholders on benefits and socio-economic impacts of actions (as a key aspect of the modelling work and activities overall). These briefings helped to build support for action implementation and scale-up through policymaking and investment. Key stakeholders in each country have provided testimonials on the value-added by this work in their respective countries.

Project Component	Project Outputs	Indicators	Means of Verification	Progress Made/Results Achieved
		communication of LEDS benefits An Africa LEDS website in place as a continental LEDS knowledge management platform	etc.) developed and presented to key stakeholders	– Website visible to global audience and updated with relevant material on project progress and key lessons. Seven hundred thousand visits registered on the site over the 3-year project cycle. -The peer exchanges continental event in Ghana published in four 3rd party online journals with a continental following. The links are as follows; https://www.modernghana.com/news/937169/eu-unep-africa-leds-project-gives-birth-to-accra-action-agen.html https://www.myjoyonline.com/world/2019/June-5th/accra-action-agenda-to-drive-climate-action-born.php https://www.environewsnigeria.com/eu-unep-africa-leds-bears-accra-action-agenda-to-drive-climate-action/?utm_source=newsletter&utm_medium=email&utm_campaign=un_chief_pledges_support_for_unga_s_president_elect&utm_term=2019-06-05 https://www.unenvironment.org/news-and-stories/press-release/eu-unep-africa-leds-project-gives-birth-accra-action-agenda-drive – Twitter account engaged to promote project progress and for real-time project progress updates and lessons sharing with global audience including non-participating countries. On average, account registers up to 1,000 impressions, 12 profile visits, 6 mentions and 12 new followers per month. – Project engaged in 3rd party continental events to share an innovative approach of maximizing both the climate and socioeconomic impacts of the implementation of NDCs – 2018 African Carbon forum.

Project Component	Project Outputs	Indicators	Means of Verification	Progress Made/Results Achieved
	Improved LEDS modelling capacity	LEDS models adapted for target high emissions sectors economy wide Training of relevant personnel to lead LEDS modelling actions Partner country technical institutes conducting analysis with adapted models	Evidence of countries having adapted and utilized one or more of the LEDS modelling tools to guide the evaluation and design of their LEDS	- Capacity built within **all countries** on development and use of integrated modelling frameworks to inform NDCs and other policies through various training sessions and technical assistance activities. - **Cameroon:** Africa LEDS team guided modelling team to develop an indigenous context specific model that forecast the long-term socioeconomic and climate impact of an investment trajectory of greening Cameroon's agro-value chains using nature-based agriculture, clean energy and ICT. As earlier described, this model was validated using data from Component 1 ground actions and has been run to inform policy on "greening and digitization" to green agro-value chains across 12 municipalities in Cameroon as part of the country's optimal NDCs implementation strategy. - **DRC:** Africa LEDS team guided country modelling team to synthesise an integrated model from the MAED model that forecasts the long-term socioeconomic and climate impact of an investment trajectory of waste to energy. As earlier described, model was successfully run and is informing government programmes on increasing the contribution of renewable energies in the energy mix and promoting the use of modern biomass - **Côte d'Ivoire:** Capacity built within Africa LEDS team to design and apply an integrated modelling system to assess climate and economic impacts for the two pilots described above, as well as for both pilots if implemented together. The modelling system includes the following tools: LEAP-IBC (Long range Energy Alternatives Planning – Integrated Benefits Calculator); EX-ACT (Ex-ante Carbon Tool); Microeconomic costs and Macroeconomic Assessment Tools from the Center for Climate Strategies analytical toolkit (CCS toolkit); and a geographic information system (GIS; as a data source for the other tools in the modelling system). - **Zambia:** Capacity was built within the modelling team through trainings and remote assistance to use and interlink the I-JEDI and LEAP models to assess both climate and

Project Component	Project Outputs	Indicators	Means of Verification	Progress Made/Results Achieved
				socio-economic impacts of key NDC actions focused on the energy and forestry sectors. - **Kenya:** Capacity was built within the modelling team through training and remote technical assistance to use the LEAP and I-JEDI models to assess climate and socio-economic impacts of key actions (further described below). - **Ghana:** Capacity was built within the modelling team through remote assistance and training as well as peer exchange with Mozambique to use and link the LEAP and Abacus models to assess climate and socio-economic impacts of agroforestry and cookstove actions. - **Mozambique:** Capacity was built within the modelling team through training and remote assistance to use and link the LEAP and Abacus models to assess climate and socio-economic impacts of solar water pump and agroforestry actions. Mozambique was also empowered to become a peer learning leader to share the approach and learning with other country partners.
	Improved regional and global knowledge	At least 2 non-partner countries report improved LEDS process due to peer-learning forums and project knowledge products Non-partner countries participate	Survey to collect feedback from countries on use of knowledge and capacity to help strengthen their LEDS and intended	- Project Component 2 lessons informed a high-level policy decision at the UN Environment Assembly (UNEA) and the Africa Ministerial Conference on the Environment (AMCEN) – AFOLU Community of Practice (CoP) shared project learning on linking models and maximizing both climate and socioeconomic aims with non-participating stakeholders across the continent through remote peer learning sessions and poised to implement further activities through end of 2019.

Project Component	Project Outputs	Indicators	Means of Verification	Progress Made/Results Achieved
		actively on LEDS modelling through knowledge platforms All 8 partner countries actively involved in LEDS modelling peer training and knowledge-sharing	nationally determined contributions Active knowledge-sharing by non-partner and partner countries observed in knowledge-sharing platforms (website, joint reports etc.)	-Mozambique team supported Ghana as peer learning partner on soft-linking models to forecast cumulative impact of investments across complementary sectors to inform optimal NDCs implementation policy decisions – Project engaged in third party continental events to share innovative approach of maximizing both the climate and socioeconomic impacts of the implementation of NDCs – the African Carbon Forum. - Africa LEDS Project culmination workshop held to share lessons and outcomes across countries. Informed by the project successes shared, 4 non-participants countries – Nigeria, Uganda, Togo and Benin led calls for adoption of the "Accra Action Agenda on Low Emission Development Strategies in Africa" —which resolves to use project results to inform NDC planning and action while urging governments across Africa to strengthen the policy and enabling environment for LEDS implementation. – Website visible to global audience updated with relevant material on project progress and key lessons. – Twitter account engaged for real-time project progress updates and lessons sharing with a global audience including non-partner countries.

Project Component	Project milestones:	Milestone progress (complete/started/near complete/not started)
Administrative	• Grant support agreements/contracts signed • Launch of the project at Africa LEDS Partnership event	Complete N/A
LEDS planning and implementation support	• Inception phase, established activities and launched implementation • Country-specific support activities. • Case studies developed and distributed • Peer-learning and networking activities • LEDS country champions identified • Close out reports for each participating country published	Complete Complete Complete Complete Complete Complete

Project Component	Project milestones:	Milestone progress (complete/started/near complete/not started)
LEDS modelling support	• Inception phase, activities established, and implementation launched • Suite of models to work with finalized – selection • Training of in-country modelling teams • Training and capacity-building of regional technical institutes • Network of regional modellers, analysts as well as technical institutes for sustainability of project outputs formulated and installed • Knowledge and communication products based on the project and the benefits of LEDS developed and shared with the global community	Complete Complete Complete Complete Complete Complete

3. Activities Carried Out

3.1 Component 1: LEDS Planning and Implementation Support

Executing a ground demonstration pilot is the leading activity. This activity entails building on already established sectoral initiatives and linking them for consolidation into a single pilot ground action that demonstrates how NDC implementation can maximize socioeconomic and climate mitigation impacts simultaneously by following the chosen strategic development trajectory in each country. Site selection was informed by feasibility studies undertaken by each respective country team. Considering that the ground demonstrations would not involve initiation of new pilot actions, the key decision criteria for selecting sites was the availability of readily-suitable ongoing actions and willing actors that could be built upon. Three countries took part in Component 1: Cameroon, Côte d'Ivoire, and the Democratic Republic of the Congo.

3.1.1 Key Activities Accomplished in Cameroon

The ground demonstration sought to practically show how the country can invest to green its agro-value chains using nature-based, climate resilient cultivation approaches, clean energy and ICT to achieve both NDC commitments and socioeconomic priorities. Accordingly, the ground action involved linking cassava grown under agroforestry with clean energy sources – solar and micro-hydro – for processing into flour and linking these products to markets using digital marketing tools. The resultant data were used to calibrate the model under Component 2. Specifically, two sites were operated. At the Jakiri municipality site, a micro-hydro plant was linked to an electric flour milling unit to power conversion of cassava sourced from a local cooperative into flour. This flour was then marketed using a digital ICT tool, AfroShop. At the Ngoulemakong municipality site, solar driers were used to dry cassava for preservation and readying it for processing. A women's cooperative, SOCOOPROMAN-COOP-CA, was the lead actor in cultivating the cassava.

Location for the Ground Demonstrations in Cameroon

The following table summarizes the activities undertaken:

Activity	Sub-activities
Activity 1: Feasibility studies to establish optimal ongoing ground actions to build on in conducting the ground demonstrations	- Clean energy feasibility studies conducted on 5 sites – three selected. - Cassava growing feasibility studies conducted in 10 sites – one cooperative selected to partner. - Cassava processing feasibility studies conducted in 5 sites – two selected. - Feasibility studies conducted on digital marketing systems - 1 selected. - Feasibility studies on cassava consumer markets to establish cassava product range popular in markets.
Activity 2: Training actors on climate action enterprise opportunities in greening agro-value chains using nature based on-farm approaches (agroforestry and apiculture), clean energy and ICTs / digital marketing tools	- Mobilising and training cassava farmers on climate resilient approaches – specifically, agroforestry and apiculture - 120 farmers were trained. - Mobilising and training ICT partners from University of Yaoundé on how to target opportunities in green agro-value chains (students developing a digital marketing application) - 40 youths and 20 professionals trained in opportunities for ICT development in the agricultural sector (AfroShop and SAPGA software training). - Mobilising and training cassava farmer cooperative members on enterprise opportunities in clean energy powered value addition of cassava (70 members of Jakiri cooperative including 40 women trained). - Mobilising and training clean energy enterprises on income opportunities in powering agro-value addition (a workshop for 11 enterprises and 20 freelancers on business opportunities in local green cassava agriculture and clean energy was conducted).
Activity 3: Greening up-steam cassava production - integrating agroforestry into cassava farms for increased carbon sinks	- Facilitate mobilization of cassava cuttings for 100 ha. - Clearing total of 100 ha of land for agroforestry farms in Jakiri and Ngoulmakong councils (50 ha each).

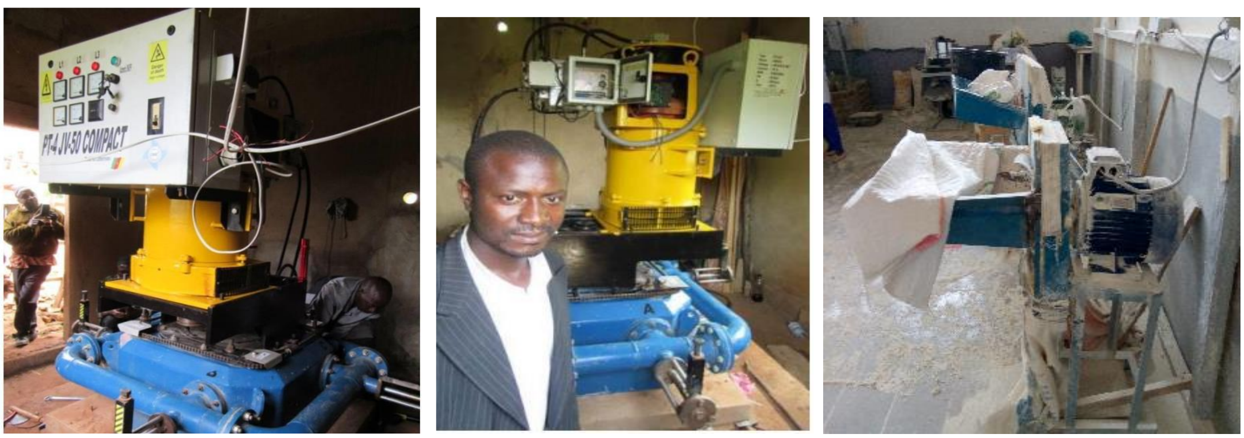
Activity	Sub-activities
	- Cultivating and watering 100 ha of cassava. - Harvesting of 100 ha cassava farm.
Activity 4: Consolidating ground demonstration site for micro-hydro powered processing (Jakiri municipality)	- Facilitating rehabilitation of micro-hydro plant at the Jakiri site. - Facilitating upgrading of micro-hydro power control unit to enable supply to the cassava milling plant. - Facilitating extending wiring of the Jakiri site to power cassava flour mills. - Facilitating upgrading of flour milling machine to enable cassava milling. - Facilitating upgrading flour milling machine to enable connection to the micro-hydro plant.
Activity 5: Consolidating ground demonstration site for cassava solar-drying units (Ngoulmakong council)	- Facilitating rehabilitation of 5 solar driers. - Facilitating expanding holding area for fresh cassava. - Facilitating expanding holding area for dried cassava. - Facilitating rehabilitation of chipping machine for dried cassava processing.
Activity 6: Market linkages	- Working with University of Yaoundé students towards facilitating expansion of Afroshop mobile application to cover cassava produce marketing.
Activity 7: Establishment and operation of the Cameroon Inter-agency policy taskforce hosted at ministry of environment	- Organizing expert meetings with policy makers on progress on ground actions and key lessons to inform policy. - Mobilising and engaging policy makers across key ministries (environment, agriculture, energy, infrastructure, industry, trade, finance, lands) and state agencies for coherent uptake of demonstration results. - Policy analysis to establish relevant inter-ministerial silos to bridge and develop cross-cutting policies – cutting across environment, agriculture, energy, infrastructure, industry, trade, finance, and lands as needed, to catalyse both private sector and government investment for

Activity	Sub-activities
	scaled-up establishment of green agro-value chains in 12 municipalities.
Activity 8: Amend sectorial policies to infuse ground action lessons for upscaling	-Developing case studies coalescing work done in both sites into an actionable report. - Organising expert group meetings to synthesise the report, amend relevant sectoral policies to facilitate inter-ministerial collaboration for an enabling environment for scaled-up establishment of green agro-value chains in 12 municipalities.
Activity 9: Capacity enhancement of policy makers on need for inter-ministerial coherence in policy implementation for NDCs	- Training workshop for policy makers on results of ground demonstration and integration into policy.
Activity 10: Documenting policy lessons	- Development of an integrated blueprint towards scaled-up establishment of green agro-value chains in 12 municipalities.

Site conversion pictures

Cassava farming showing agroforestry and harvest handling

Solar drying of cassava – Ngoulemakong site



Micro-hydro powered cassava flour milling – Jakiri site

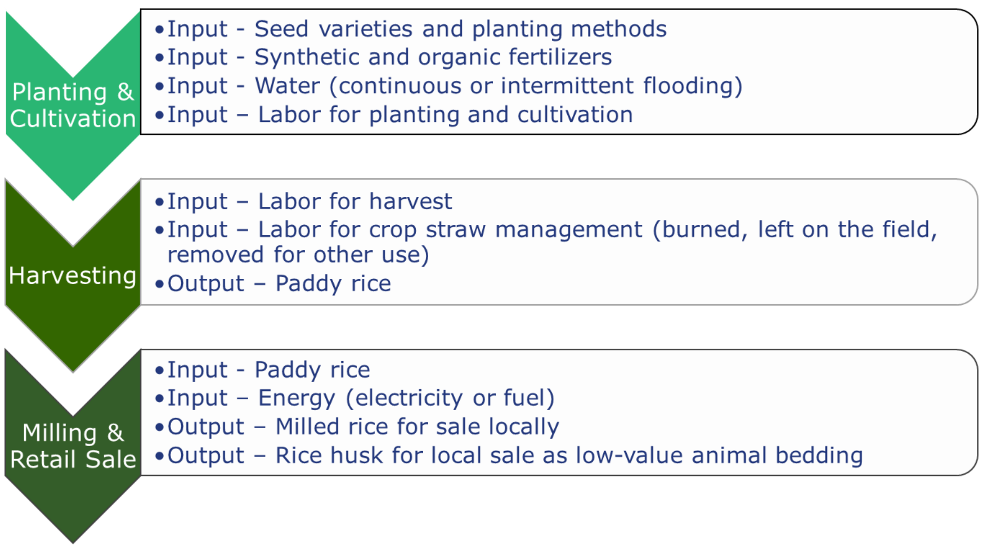
Placard placed on site of the clean energy powered cassava conversion operations

Blueprint of the "green agro-value chains" to scale out demonstrations in 12 municipalities across Cameroon

3.1.2 Key Activities Accomplished in Côte d'Ivoire

Côte d'Ivoire's Africa LEDS activities focused on three of the highest emitting sectors in the country, agriculture, energy demand, and the forestry and other land use (FOLU) sector. Côte d'Ivoire's agriculture sector and energy demand for cooking fuel wood contribute to deforestation in a country with one of the highest rates of deforestation in the world. To support reductions in deforestation, reduced emissions and broader development goals, the Africa LEDS activities in Côte d'Ivoire focused on replacing cooking wood fuel with rice husk briquettes (Pilot 1) and broader climate smart agriculture for rice production (Pilot 2). These activities also provide a clear link between the energy, agriculture and FOLU sectors allowing for synergies across the sectors and aligning with broader objectives under the Africa LEDS Project. The figure below provides a basic overview of the rice value chain for small producers consistent with the study area for the pilots in the region of Gagnoa (see map below). As described further below, the pilots address activities in all 3 phases of production.

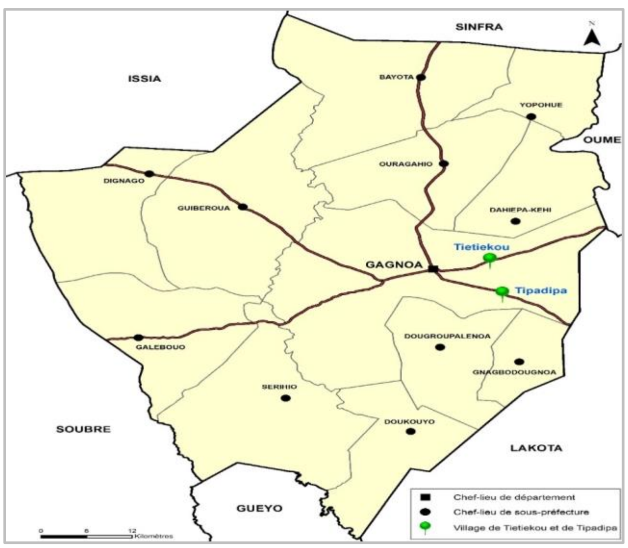
Typical Small-Producer Rice Value Chain



For Pilot 1, the Africa LEDS project team worked to bring value to agricultural waste in order to reduce agricultural waste streams and GHG emissions while fostering local economic activity. The team worked with the local rice mill operator in the town of Gagnoa to assess the added value to her business for an ongoing rice husk briquetting process. The rice husk produced by the mill has been either open burned as a waste material or sold as low value animal bedding. Early attempts to produce cooking fuel briquettes directly from rice husk proved unsuccessful, since those briquettes produced too much smoke and ash. Recently, the mill operator then added a rice husk pyrolizer (carbonizer) to the process to produce a material that had performance characteristics much closer to the wood and charcoal that it would offset if accepted in the local market.

Location of Gagnoa in Southwest Côte d'Ivoire

Map Showing the Locations of Rice Value Chain Pilot Studies



By surveying about 100 households and restaurants, the Africa LEDS Project team confirmed that the current market sentiment is that rice husk briquettes have a low energy capacity and poor combustion characteristics. Therefore, local marketing strategies need to be developed and implemented in order to gain wider acceptance by the public. The project team supported this by completing a socio-economic cooking test study which initiated better local market acceptance and also determined that briquettes are best used in specific types of cook stoves. The project team also assessed the cash flows in a business plan analysis.

These cash flows covered those for the rice mill operator for adding in the rice husk briquetting process as compared to business as usual (BAU) treatment of rice husk as low value animal bedding or waste material.

For Pilot 2, the Africa LEDS team started by assessing the BAU situation of rice farming and determined that growers use inorganic fertilizer and dispose of rice by-products (crop straw) through open burning. A second BAU study, based on interviews with 75 farmers, was also completed to inform climate smart agriculture activities within the rice sector. These data were also used for modeling elaborated in Section 3.2, including the avoided demand place on forest carbon for production of wood/charcoal.

Building on the studies for Pilot 2, the team identified rice producers in two communities 20 km north of Gagnoa and worked to educate the farmers on climate-smart agriculture through demonstrations of agricultural practices and trainings. Climate smart practices included: a switch from continuously-flooded irrigation systems to intermittent flooding systems (for reduction of methane emissions); composting of crop straw and animal manure for displacement of chemical fertilizer and avoidance of agricultural burning; and the use of higher quality seedlings and planting methods (increased yields). The team held development training sessions focused on water management and water infrastructure as well as low carbon planting and cultivation techniques. The Africa LEDS team also trained rice farmers on composting as well as two water management and two rice marketing committees to carry this work and ongoing training forward after the completion of the Africa LEDS Project.

The following table summarizes the activities undertaken:

Activity	Sub-activities
Activity 1: feasibility study, farmer capacity building for climate- smart agriculture application of intensive rice farming systems	- Identification missions for beneficiary rice farmers and mapping of local stakeholders - surveying about 100 households and restaurants to establish energy partners and current market sentiment on rice husk briquettes to establish market gap - cash flows and business plan analysis for returns to rice mill operator for adding in the rice husk briquetting process as compared to business as usual (BAU) treatment of rice husk as low value animal bedding or waste material - Rehabilitation of rice farms to implement climate smart rice cultivation practices: ➢ land preparation – bush clearing and levelling (two 50 ha sites in Tipadipa and Tiétiékou) ➢ rehabilitation of irrigation water channels – cleaning and desilting

Activity	Sub-activities
	➢ acquisition and distribution of rice seedlings and fertiliser ➢ preparation and maintenance of rice seedling beds ➢ harvesting and storage of rice straw from 100ha rice farm ➢ composting of rice straw with manure ➢ re-application of composted rice straw as an organic fertilizer - Training, supervision and monitoring of beneficiary farmers on Sustainable Rice Intensification application, rice marketing, production of biofertilizer from composted rice straw, water management infrastructure, sustainable agricultural practices, - 87 rice growers and other professionals trained
Activity 2: support production and trade of fuel briquettes made from rice husks	- Facilitate construction of the pyrolysis reactor for fuel briquettes production - Facilitate rehabilitation of briquette making machines by the Africa Business Group - Facilitate marketing of briquettes by the Africa Business Group - Facilitate testing of briquettes in clean cookstoves and collect data - Facilitate laboratory testing towards improving the quality of fuel briquettes - Training on socioeconomic aspects and marketing of briquettes and development of business plan studies

Activity	Sub-activities
Activity 3: coordination of field activities	- Coordination of activities (Ministry of the Environment, ANADER) - Development of case study based on the demonstration project - Modeling of the impacts of each pilot implemented separately and together. Scale-up of those results to the national level.

Demonstration Site Pictures

Left: smart rice cultivation plot; Right: rice husk storage pile; ready for carbonization and conversion to briquettes

Left: back of rice mill showing rice husk storage pile; Right: rice mill owner (left) and technical support specialist (right)

Front of the rice mill in Gagnoa

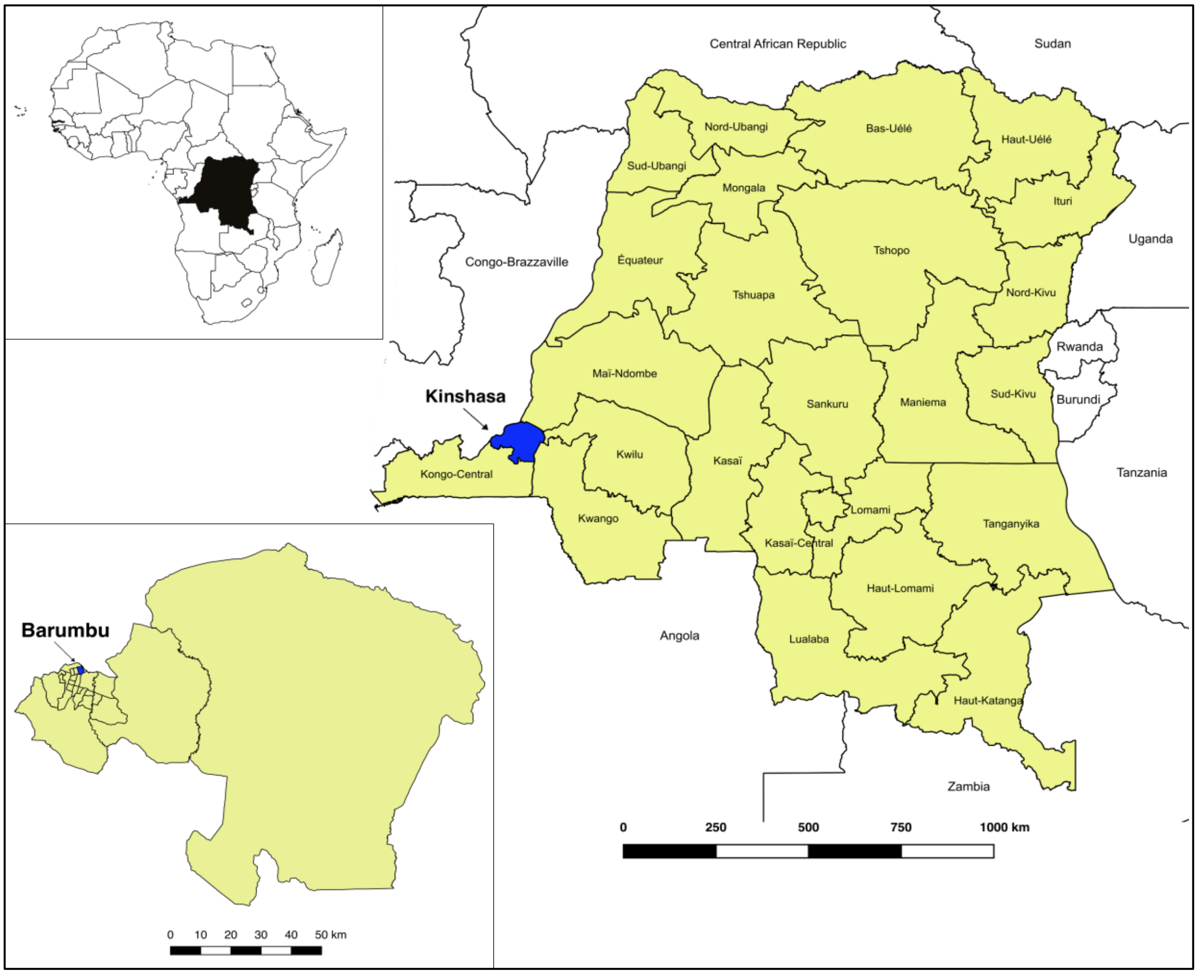
Left: original dried husk biomass briquette without carbonization (pyrolysis). Right: finished briquettes ready for use after pyrolysis to burn cleaner and produce more energy per unit of mass

Placard placed on site of a Sustainable Rice Intensification pilot plot, which is also source of the rice straw that provides raw material for making compost (in place of BAU burning of rice straw)

3.1.3 Key Activities Accomplished in the Democratic Republic of the Congo

The ground demonstration showed how the Democratic Republic of the Congo (DRC) can strategically implement NDCs in energy, forestry and waste management in a manner that simultaneously maximizes both climate and socioeconomic benefits. Accordingly, the demonstration focused on waste recovery / waste-to-energy linked to enhance the country's REDD+ process based on two techniques: converting organic waste to biogas for domestic and institutional use, including in eateries; and converting general solid waste to fuel briquettes for sale. Ground actions were undertaken at two sites, while another two sites were used for comparative analysis of results. Actions took place in Barumbu, Limete, Matete and Ngaliema municipalities.

Map showing the locations of the DRC ground demonstrations



Below is a summary of activities undertaken.:

Activity	Sub-activities
Feasibility studies to establish optimal ongoing ground actions to build on in conducting ground demonstrations	- Mapping and identification of local stakeholders involved in the production of improved stoves and in the production of biogas and briquettes (modern biomass). - Establishing appropriate sites for comparative analysis of efficiency of improved cookstoves vis-à-vis traditional charcoal and firewood stoves used by the majority.

Activity	Sub-activities
Consolidating ground demonstration of waste to biogas stoves and waste to briquettes.	- Working with waste collectors to develop a structured waste collection approach that separates organic waste for use as raw material for briquette / biogas production. Facilitate them to acquire separate collection tanks, work with households and eateries to harvest and transfer more organic waste. - Facilitate installation of longer pipelines and fittings to supply biogas stoves for experimentation at the Higher Institute of Applied Techniques (ISTA) in Ndolo District in the municipality of Barumbu. - Restoration of manual press for processing waste to briquettes.
Practical demonstration of production of biomass briquettes and use in improved stoves at the ISTA site in Ndolo District.	- Facilitate rehabilitation of energy-efficient cookstoves using briquettes. - Rehabilitation of biogas stoves and collection tanks.
Demonstrate energy recovery of household waste, sawdust and other agro-industrial and agricultural residues in the municipality of Limete site.	- Facilitating local carpenters to supply sawdust for use as raw material for binding briquettes. - Facilitate rehabilitation of biogas stoves and collection tanks.
Comparative analysis of the energy efficiency of different types of stoves (traditional stoves versus improved stoves) and fuels (charcoal versus modern biomass briquettes) conducted at the municipality of Matete site.	- Working with local eateries (up to 10) to use their traditional stoves as control experiment. - Working with local households to use their traditional stoves as control experiment. - Working with ISTA and the green space network to distribute improved cookstoves to eateries and households to test efficiency.
Comparative analysis of the energy efficiency in the use of different types of stoves (traditional stoves versus improved stoves) and fuels (charcoal versus modern biomass briquettes) conducted at Ngaliema municipality site.	- Guiding and facilitating project team to work with local eateries (up to 10) to use their traditional stoves as control experiment. - Guiding and facilitating project team to work with local households to use their traditional stoves as control experiment. - Facilitating ISTA and the green space network to distribute improved cookstoves to eateries and households to test efficiency.

Activity	Sub-activities
Working sessions to share and validate the results of the demonstration exercise.	Hands on training seminars organised at ISTA, and the Green Space Network NGO campuses including lab work.

Triangulating and averaging results from the four sites showed that improved stoves decrease the amount of charcoal consumed per average household by 5.8 kg/week. In addition, biomass briquettes (made from agricultural residues, wood processing and sawmill waste) could be suitable feedstocks with low production costs and higher efficiency than traditional charcoal.

Site conversion pictures

Briquette making at ISTA site. **Left**: preparing the waste. **Right**: processed briquettes.

Briquette testing

Biogas testing

3.2 Component 2: LEDS Modelling Support

This component sought to enhance existing modelling capacity in countries to move beyond modelling and forecasting emission scenarios alone, as is classically done, towards forecasting both climate and socioeconomic impacts simultaneously. Component 2 actions built on existing modelling capacity within countries and forged a country-driven approach to implementation of activities. In the end, actions established decision-support systems to inform policy makers on optimal NDC implementation pathways that maximize both climate and socioeconomic benefits based on key sectors in each country. Considering that such socioeconomic ends remain the leading priorities of countries, this component provided analytical tools to catalyse a demand-driven, country-led economic transition towards a low emissions development pathway.

3.2.1 Component 1 and 2 Countries

3.2.1.1 Key Activities Accomplished in Cameroon

Based on the country's emissions and development goals, five key sectors were selected by the Cameroon LEDS modelling team for analysis: agriculture, transportation, energy, forestry, and waste. Information and Communications Technology (ICT) was also integrated with the work as a complementary enabling force across sectors. In the Cameroon LEDS context, the central sector is agriculture, as the sector is a key priority within the country's development vision, "Vision 2035", as well as for development within the African Union. The Cameroon team chose to build an indigenous model, using both mathematical and statistical algorithms, which is executed via a simple computer programme to forecast the relevant scenarios. The model used by the Cameroon team evaluated activities at the program and project level. It assessed GHG emissions, cost savings, net investment, net job creation, GDP, and gross regional product impacts of various options. The model was developed based on international and proven sources, including IPCC approaches, and other experiences operating in a similar environment. The model also relied mainly on theoretical concepts readily adaptable to the context of Cameroon. The main features of the designed model meet the following principles:

- Stochastic model: model admits laws of probability, especially when activities develop over time.
- Smart model: the reference model is designed in an integrated form with agriculture as the main sector; the model being intelligent, mutations can take place, and, for example, each sector can become the main sector according to its evolution.
- Dynamic model: the model is not fixed; it can evolve by integrating new innovations to justify its dynamic character.

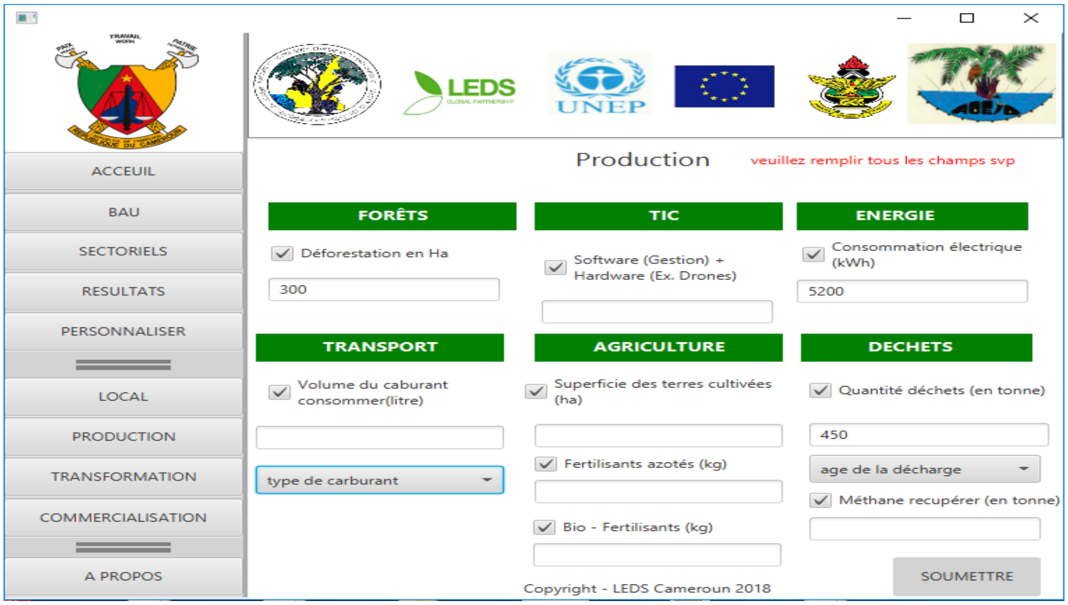
To validate and calibrate the model, data from the ground demonstration actions as presented in Section 3.1.1, were used. The model compared a BAU scenario to a Ngoulmakong project scenario (based on data from the demonstration) to assess GHG emissions and other socio-economic costs and benefits of the two scenarios. The model analysis findings were as presented in Section 2. The following is a breakdown of activities undertaken:

Activity	Sub-activities
Mobilize stakeholders for participatory process in establishing baseline / GHG inventory for Cameroon.	- Facilitate data evaluation and compilation of the GHG inventory by the ministry of environment. - Facilitate data cleaning by Cameroon modelling team.
Development of integrated model prototype for modelling scenarios in greening Cameroon agro-value chains using clean energy, ICT, waste-to-fertilizer and transport.	Facilitating the modelling team to conduct the following technical sessions: - Literature review on most appropriate mathematical and statistical models to fit the envisaged modelling scenarios. - Development of contextual mathematical and statistical models for envisaged scenarios. - Literature review on computer software development tools and selection of most appropriate tools. - Analysis and cleaning of Component 1 data modules to validate the mathematical model. - Solving, running and refining mathematical model. - hands on development of computer programme to automate the mathematical / statistical model. - Develop prototype computer model. - Test-running and validating the prototype model with Component 1 data.
Prototype model review - engage stakeholders, especially those engaged in inception workshop from academia and government technical units in ministry of agriculture, energy, lands, forestry, and environment - especially in the National Observatory on Climate Change (ONACC), for participatory process with technical partners in validating models.	- Scouting key stakeholders from academia, government technical and lead agency institutions and policy makers to review prototype model during validation test runs. - Organising two-day workshop for internal model validation process. - Compiling recommendations from the review team. - Revising model components based on feedback from review team.

Organize training workshop for above stakeholders on use of the adapted models (3 days).	- Facilitation and logistics for training workshop for all key stakeholders on model background, development and use. - Handing over flash-drive copies of model to policy makers for use in forecasting impacts of various alternative NDC implementation trajectories along the agriculture, energy and transport sectors.

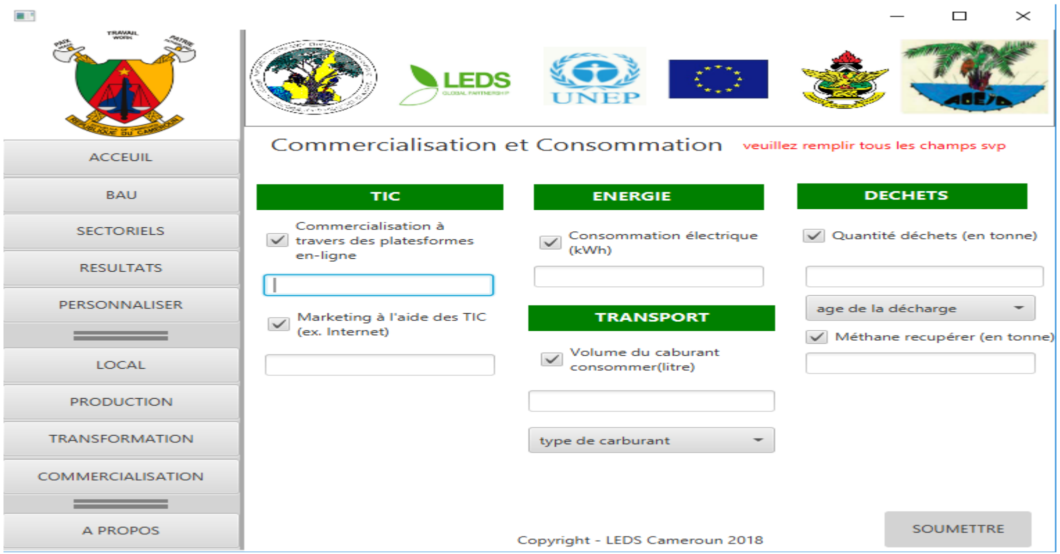
Model Development and Testing Screenshots

Homepage of the Cameroon indigenous model

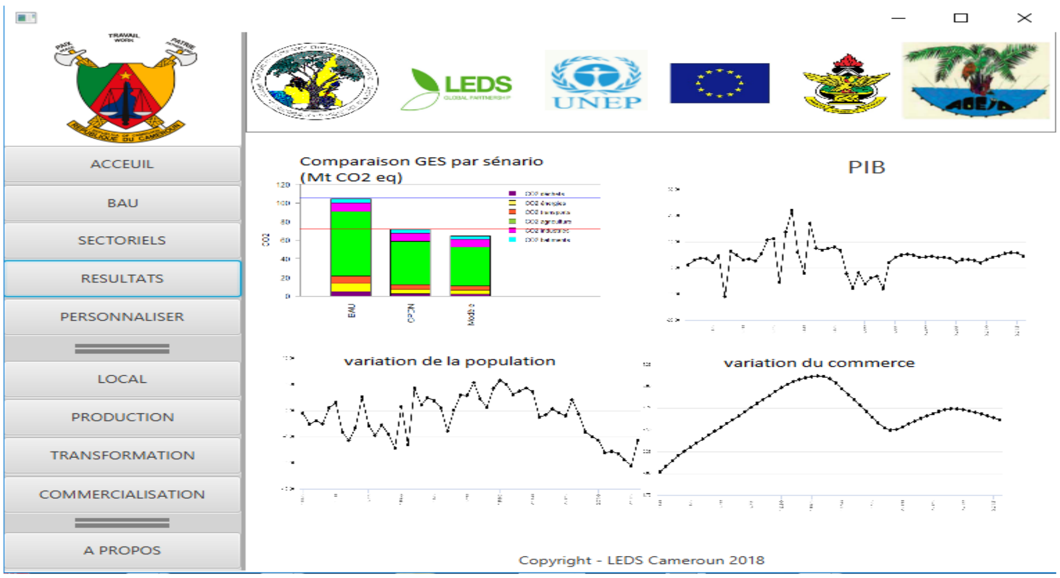


Calculation page of emissions related to production

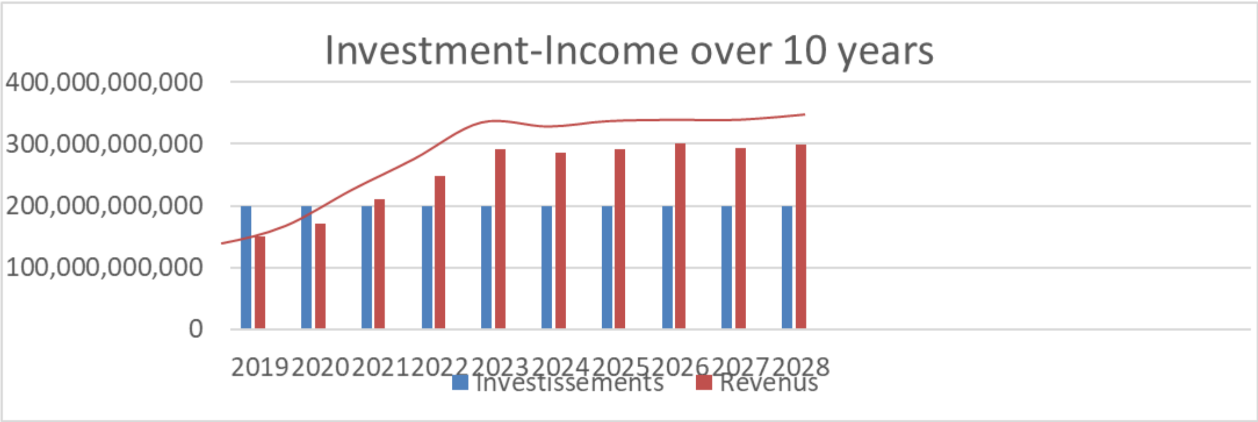
Calculation page of emissions related to processing / value addition / transformation



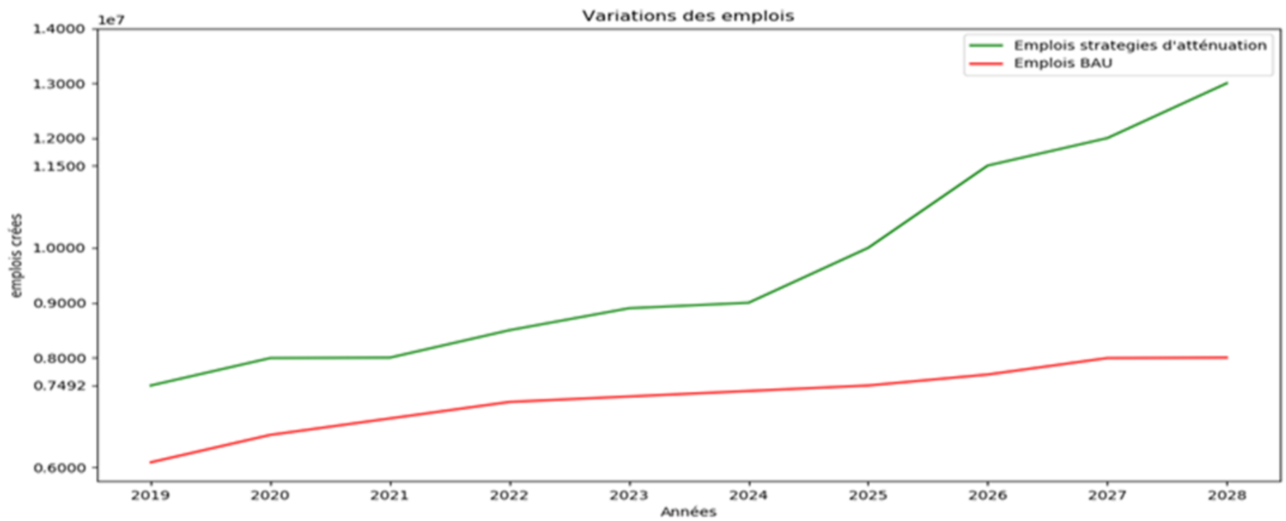
Calculation page of emissions related to consumption



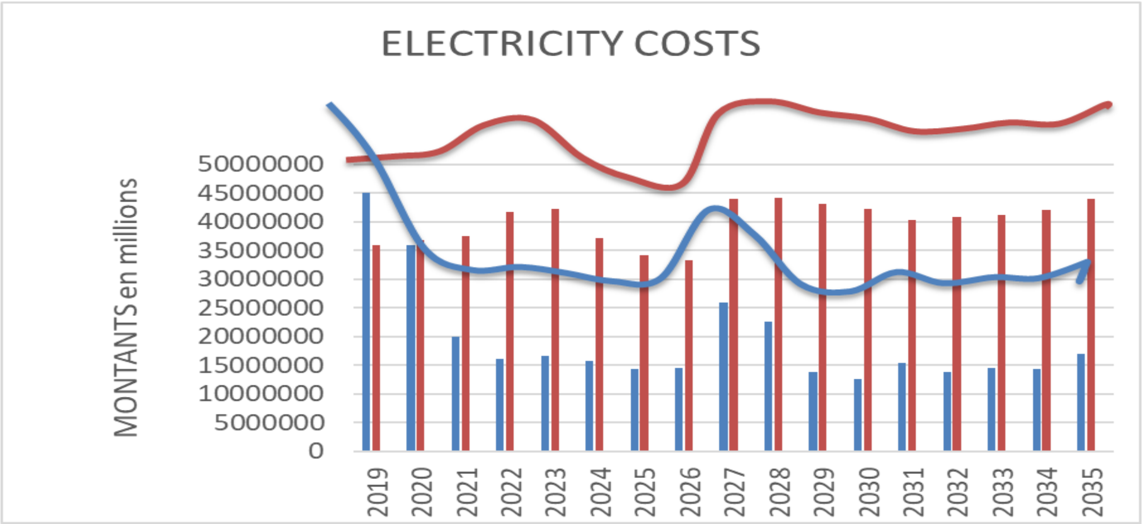
Results page showing socioeconomic aspects (GDP, population and trade) vis-à-vis emissions.



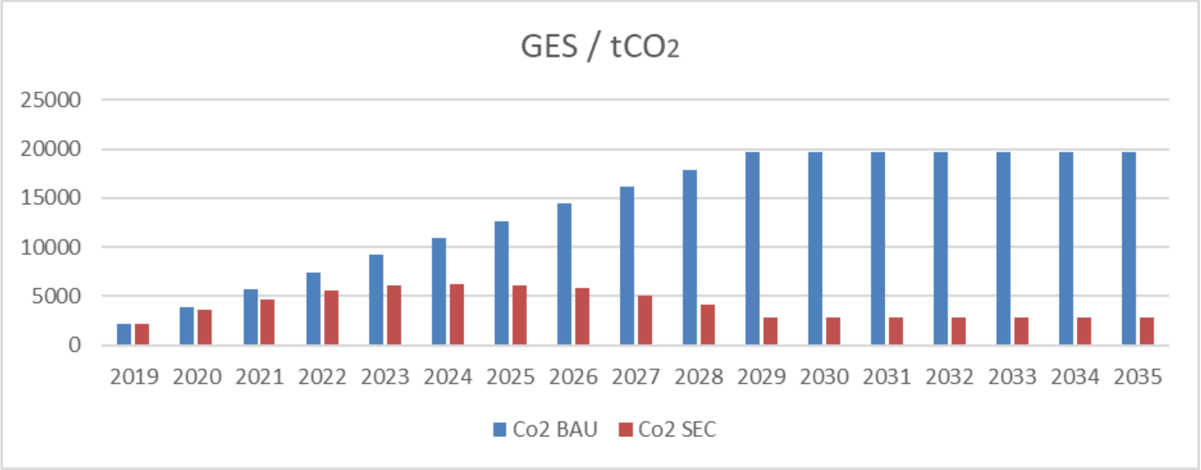
Results page for implementing NDCs by investing in greening and maximising productivity of Cameroon's agro-value chains using agroforestry, clean energy and ICT. Results show that by upscaling this trajectory to cover all five agro-ecological zones of Cameroon will break even by 2021 and that revenues will almost double investment costs in 10 years.



Results page indicating that implementing NDCs by greening and maximising productivity of Cameroon's agro-value chains using agroforestry, clean energy and ICT, which would entail upscaling actions demonstrated under Component 1 to national scale will produce 13 million assorted jobs along the agro-value chain including in ICT and clean energy. A BAU scenario of silo investment by sector will at best produce only 8 million jobs.



Results page indicating investing in off-grid clean energy electrification to power greening of the agro-value chain will cost less than BAU grid connections and diesel generators in place.



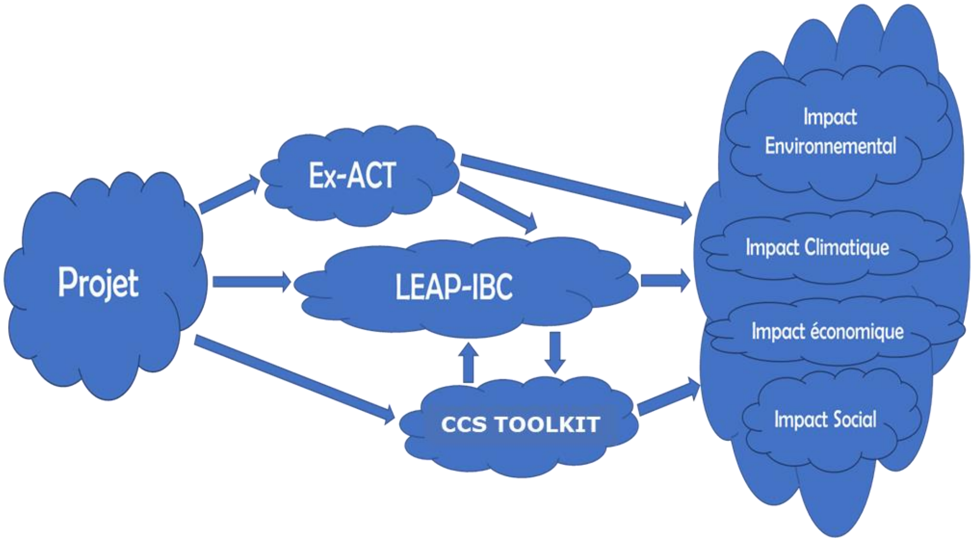
Results page indicating implementing NDCs by investing to green and maximise productivity of Cameroon's agro-value chains using agroforestry, clean energy and ICT upscaling actions being demonstrated under Component 1 will mitigate more carbon than a BAU scenario of silo investment by sector.

3.2.1.2 Key Activities Accomplished in Côte d'Ivoire

The Africa LEDS team designed and applied an integrated modelling system shown in the Figure below to assess climate and economic impacts for the two pilots described above, as well as for both pilots if implemented together. The modelling system includes the following tools: LEAP-IBC (Long range Energy Alternatives Planning – Integrated Benefits Calculator); EX-ACT (Ex-ante Carbon Tool); Microeconomic costs and Macroeconomic Assessment Tools from the Center for Climate Strategies analytical toolkit (CCS toolkit); and a geographic information system (GIS; as a data source for the other tools in the modelling system).

The following is a breakdown of additional activities that were undertaken in modelling the ground demonstrations and their scale-up as described previously:

Activity	Sub-activities
Capacity building of the modelling team.	Training and capacity building workshops focusing on key modelling tools used: - LEAP, EX-ACT, CCS toolkit - for Côte d'Ivoire national experts.
Design, modelling, and communication of the LEDS strategy with the actors involved in the implementation of NDCs.	- Facilitating acquisition of modelling tools (computer, satellite image, external hard disk). - Hands-on LEDS modelling training between CCS and the Côte d'Ivoire national team. Selection and design of the integrated modelling system. - Familiarizing the integrated model with stakeholders (Academic, sector ministries and development agencies) through facilitating training forum. - Data gathering to support modelling of both ground demonstrations: field missions and literature searches. - Review of draft interim results with CCS and the Côte d'Ivoire national team.
Coordination of modelling activities.	- Coordination of modelling work (Ministry of Environment, Modelling Team, Political Task Force). - Final team workshop to review final results of direct and indirect impacts at the demonstration and national scale-up levels. - Project close-out workshop to present results to policy actors.



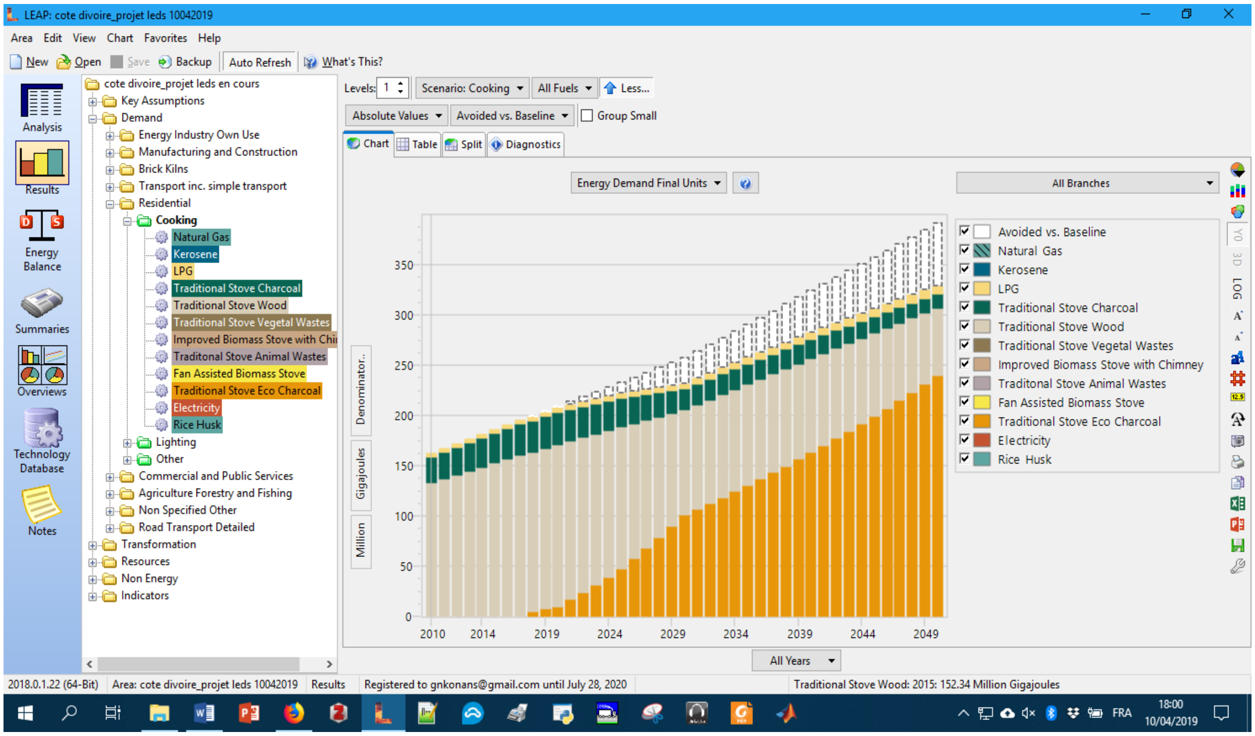
Modelling Tools Selected for the Côte d'Ivoire LEDS Modelling System

A summary is provided below for each of the 3 primary tools to describe how they were applied, and the results obtained:

- **LEAP-IBC:** Over the long-term, the model developed for application in this project is expected to become the central tool within the modelling system, providing integrated impacts assessment across the energy and non-energy sectors. Although LEAP-IBC is generally known and applied as a system to develop models of the energy system of a jurisdiction, advanced users can extend to incorporate data from the non-energy sectors (agriculture, FOLU and waste management) either directly or through linkages to the other tools allowing for complete economy-wide tracking of energy, resource and emissions impacts. Currently, the ALEDS team is establishing linkages to the EX-ACT tool and to tools within the CCS toolkit to allow for assessments of both direct (micro-) and indirect (macro-) impacts across the energy and non-energy sectors.

  The Figure below provides a screenshot showing expected national scale impacts of the use of rice husk briquettes to displace fossil fuel and forest biomass cooking fuels.

Sample Screenshot from the LEAP-IBC Cote d'Ivoire Model. This screenshot indicates the expected avoided GHG emissions at the national level for production and use of rice husk briquettes as a cooking fuel.



- **EX-ACT:** this MS-Excel based tool was applied to assess GHG reductions for Pilot 2 (climate smart rice cultivation). The Figure below provides a screenshot with summary results.

Sample Screenshot from the Application of EX-ACT for the Pilot 2 Analysis of Climate Smart Rice Cultivation. These results indicate total GHG reductions of 396 tCO_2e/yr for a 150.5 ha pilot project.

Project Name: *0* | Climate: *Tropical (Moist)* | Duration of the Project (Years): *32*
Continent: *Africa* | Dominant Regional Soil Type: *LAC Soils* | Total area (ha): *150.5*

Components of the project	Gross fluxes (All GHG in tCO2eq; Positive = source / negative = sink) Without	With	Balance	Share per GHG of the Balance (All GHG in tCO2eq) CO_2 Biomass	CO_2 Soil	CO_2 Other	N_2O	CH_4	Result per year Without	With	Balance
Land use changes											
Deforestation	0	0	0	0	0		0	0	0	0	0
Afforestation	0	0	0	0	0		0	0	0	0	0
Other LUC	0	0	0	0	0		0	0	0	0	0
Agriculture											
Annual	0	0	0	0	0		0	0	0	0	0
Perennial	0	0	0	0	0		0	0	0	0	0
Rice	19,488	6,911	-12,577	0	-2,856		-167	-9,555	609	216	-393
Grassland & Livestocks											
Grassland	0	0	0	0	0		0	0	0	0	0
Livestocks	0	0	0				0	0	0	0	0
Degradation & Management	0	0	0	0	0		0	0	0	0	0
Coastal wetlands	0	0	0	0	0		0	0	0	0	0
Inputs & Investments	1,902	1,816	-86			-67	-20	0	59	57	-3
Fishery & Aquaculture	0	0	0			0	0	0	0	0	0
Total	21,391	8,727	**-12,664**	0	-2,856	-67	-186	-9,555	668	273	-396
Per hectare	142	58	-84	-0.4	-19.0	-0.4	-1.2	-63.5			
Per hectare per year	4.4	1.8	-2.6	0.0	-0.6	0.0	0.0	-2.0	4.4	1.8	-2.6

- **CCS Toolkit:** two MS-Excel based tools were selected to assess:

  1. Cost impacts (micro-economic or direct impacts) for both pilots and then to also assess the combined impacts for implementing both ground demonstrations simultaneously; and

  2. The potential for positive socio-economic (macro-economic or indirect) impacts resulting from implementing one or both ground demonstrations.

The CCS micro-analysis tool served two purposes: 1. assessing energy and non-energy impacts and costs for both pilots (in the future, the Africa LEDS team plans to conduct these combined energy and non-energy assessments within LEAP-IBC); and 2. As a quality assurance (QA) check against the application of both LEAP-IBC and EX-ACT (the CCS tools are completely transparent allowing for an analyst to follow the calculation of each result back to the initial inputs). As of the writing of this report, the Africa LEDS team is still conducting this QA check.

The Figure below is a screenshot from the CCS Micro-economic Analysis Tool which summarizes the direct cost results for implementing both pilots described above together. At the pilot scale, total societal costs for implementing both pilots indicate a net savings of almost 1.7 billion central African francs (XOF; about 2.1 million USD). These net savings come from: avoided fertilizer and fossil fuel costs, as well as an increase in paddy rice yields.

Sample Screenshot from the Application of the CCS Micro-economic Analysis Tool for implementing both ground demonstrations (pilot projects) together.

Changement net: énergie, matériaux et émissions Energy & Emissions Change					
	Scenario 2 Pilote			Scenario 1 Pilote	Scenario 3: Les deux pilotes
	Engrais azoté chimique appliqué	**Paille de riz brûlée**	**Total des impacts de GES**	**Total des impacts de GES**	**Total des impacts de GES**
An	N Fertilizer Use	Rice Straw Burned	Total GHG Impacts	Total GHG Impacts	Total GHG Impacts
Year	**kg N**	**kg**	**tCO_2e**	**tCO_2e**	**tCO_2e**
2019	(14,147)	(312,127)	(716)	(157)	(873)
2020	(14,147)	(312,127)	(716)	(157)	(873)
2025	(14,147)	(312,127)	(716)	(157)	(873)
2030	(14,147)	(312,127)	(716)	(157)	(873)
2035	(14,147)	(312,127)	(335)	(157)	(492)
2040	(14,147)	(312,127)	(335)	(157)	(492)
2045	(14,147)	(312,127)	(335)	(157)	(492)
2050	(14,147)	(312,127)	(335)	(157)	(492)
Somme	**(452,704)**	**(9,988,071)**	**(15,288)**	**(5,039)**	**(20,328)**

Coûts sociétaux directs nets Net Direct Societal Costs					
				Scénario 3	Scénario 3
	Scénario 2	Scénario 1	Scénario 1	Les deux scénarios	Les deux scénarios
An	**Total des coûts du programme actualisés**	**Total des coûts du programme actualisés**	**Total des coûts du programme actualisés**	**Total des coûts du programme actualisés**	**Efficacité des coûts** Cost Effectiveness
Year	**CFA 2019**	**CFA**	**CFA 2019**	**CFA 2019**	**CFA 2019/tCO_2e**
2019	-94,440,274 CFA	-8,009,049 CFA	-8,009,049 CFA	-102,449,322 CFA	
2020	-89,907,140 CFA	-8,183,471 CFA	-7,637,906 CFA	-97,545,046 CFA	
2025	-70,303,821 CFA	-9,109,322 CFA	-6,021,528 CFA	-76,325,349 CFA	
2030	-54,974,801 CFA	-10,131,537 CFA	-4,743,292 CFA	-59,718,093 CFA	
2035	-42,988,116 CFA	-11,972,180 CFA	-3,969,736 CFA	-46,957,852 CFA	
2040	-33,615,003 CFA	-13,218,254 CFA	-3,104,177 CFA	-36,719,179 CFA	
2045	-26,285,600 CFA	-14,594,021 CFA	-2,427,343 CFA	-28,712,943 CFA	
2050	-20,554,297 CFA	-16,112,978 CFA	-1,898,086 CFA	-22,452,383 CFA	
Somme	**-1,559,845,468 CFA**	**-375,027,132 CFA**	**-137,157,767 CFA**	**-1,697,003,235 CFA**	**-83,483 CFA**

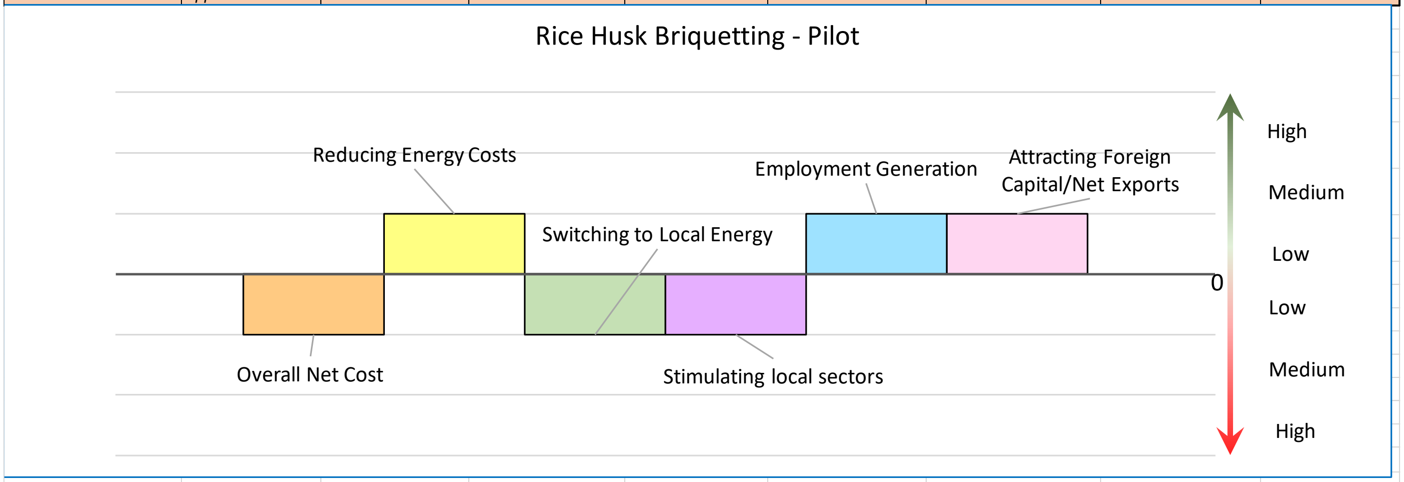
To address socio-economic impacts for the pilots, the CCS Macro-economic Indicators Tool was applied. During its assessment of available macro-economic modeling tools, the Africa LEDS team did not identify an existing model that is in use and accessible that met its objectives for transparency, affordability, and flexibility. In response, CCS developed a local version of its Macroeconomic Indicators Tool for Côte d'Ivoire. The CCS tool is MS Excel-based and designed to use the results from the micro-economic analysis shown above as an input to assessing *the potential* for positive socio-economic impacts (specifically, local gross regional product or GRP). Qualitative results are produced for six criteria of direct monetary flows that have been shown to drive positive or negative GRP impacts.[3]

For Pilot 1 (local briquette production and use), positive results include the shift from imported kerosene and local charcoal to local rice husk briquettes which can stimulate the local economy and support job growth. There are two causes of concern: creating rice husk briquettes is more expensive than some of the BAU energy sources (wood/charcoal); and the displacement of locally-derived wood/charcoal with rice husk briquettes will impact local employment in that sector. For Pilot 2 (smart irrigation for rice production) the positives include a lower net cost than BAU, more local spending, higher direct employment, and a reduced demand for chemical nitrogen fertilizers (imported). The combination of both pilots has many positive indicators. The overall net cost is lower than BAU, more localized energy spending and the subsequent local economic growth, more localized spending on agricultural products and more direct employment. The combination also causes the overall cost of energy to decrease. The Figure below is a screenshot of the results from the tool which indicates that implementation of both pilots is expected to produce positive local socio-economic impacts (4 indicators are aligned with positive GRP impacts and 2 are opposed). Another key finding is that any subsequent implementation at scale for these pilots should address the loss of local jobs in gathering and processing forest biomass.

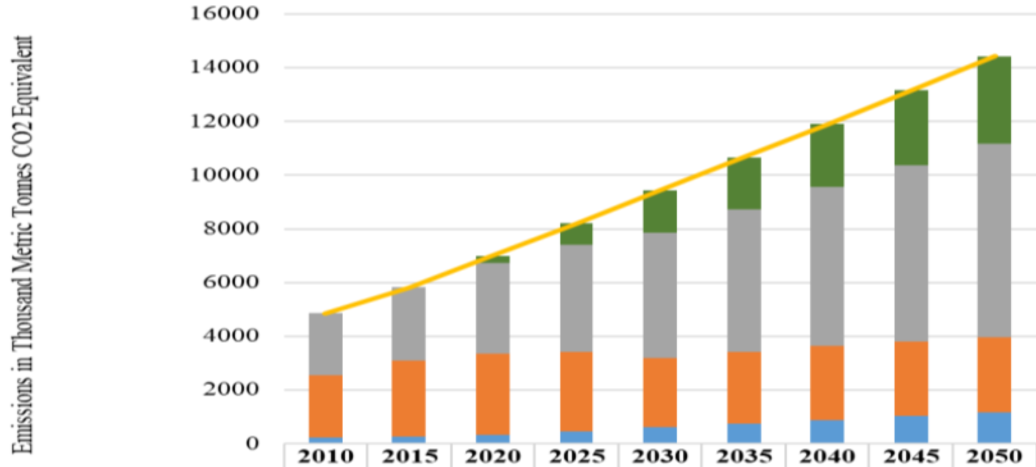
[3] These criteria are: changes from baseline total net direct costs; changes in the savings and costs of energy; shifts to locally derived energy or other products; shifts to labor intensive activities; and attraction of and shifts to outside investment

Sample Screenshot from the application of the CCS Macroeconomic Analysis Tool for the Rice Husk Briquetting Pilot. The top table summarizes disaggregated costs and savings (from the microeconomic analysis results) while the bottom chart summarizes economic-growth indicators associated with those costs and savings, their direction, and relative scale of impact.

Scénario du programme pilote: coûts directs (Différence due à la politique)								
valeur perdue du produit en balle de riz	**Coûts d'équipement de production de briquettes**	**Coûts d'équipement annualisés**	**Production de briquettes: travail**	**Autres intrants de production**	**Coûts d'électricité**	**Bénéfice de l'opérateur d'une rizière sur les ventes de briquettes**	**Coût évité du kérosène**	**Coût évité du charbon de bois**
Lost Sales of Rice Husk for Animal Bedding	Briquette Production Equipment Costs (paid by subsidy from FAO)	Briquette Production Equipment Costs (Annualized)	Briquette Production Labor	Other Production Input Costs (Clay and Cassava starch as binders)	Electricity Cost to run equipment	Rice Mill Operator Profit on Briquette Sales	Avoided Cost of Kerosene (Savings from reduced kerosene purchase)	Avoided Cost of Charcoal (savings from reduced charcoal purchase)
(XOF)	*(XOF)*	*(XOF)*	*(XOF)*	*(XOF)*	*(XOF)*	*(XOF)*	*(XOF)*	*(XOF)*
(XOF 2,700,000)	(XOF 2,500,000)	(XOF 355,944)	(XOF 33,120)	(XOF 414,000)	(XOF 163,033)	(XOF 360,149)	XOF 6,259,680	XOF 274,569
(XOF 2,754,000)	XOF 0	(XOF 355,944)	(XOF 33,782)	(XOF 422,280)	(XOF 166,294)	(XOF 364,420)	XOF 6,384,874	XOF 280,061
(XOF 3,040,639)	XOF 0	(XOF 355,944)	(XOF 37,298)	(XOF 466,231)	(XOF 183,602)	(XOF 387,092)	XOF 7,049,416	XOF 309,209
(XOF 3,357,111)	XOF 0	XOF 0	(XOF 41,181)	(XOF 514,757)	(XOF 202,711)	(XOF 412,123)	XOF 7,783,125	XOF 341,392
(XOF 3,706,521)	XOF 0	XOF 0	(XOF 45,467)	(XOF 568,333)	(XOF 223,810)	(XOF 293,163)	XOF 8,593,199	XOF 376,925
(XOF 4,092,299)	XOF 0	XOF 0	(XOF 50,199)	(XOF 627,486)	(XOF 247,104)	(XOF 323,676)	XOF 9,487,586	XOF 416,155
(XOF 4,518,229)	XOF 0	XOF 0	(XOF 55,424)	(XOF 692,795)	(XOF 272,823)	(XOF 357,364)	XOF 10,475,062	XOF 459,469
(XOF 4,988,490)	XOF 0	XOF 0	(XOF 61,192)	(XOF 764,902)	(XOF 301,218)	(XOF 394,559)	XOF 11,565,315	XOF 507,291
(XOF 119,412,980)	(XOF 2,500,000)	(XOF 3,559,438)	(XOF 1,464,799)	XOF 9,368,422	(XOF 7,210,474)	(XOF 11,643,776)	XOF 276,847,053	XOF 12,143,377
Stimuler les secteurs locaux	*Attirer des capitaux/exportations nettes*	*Choisis un indicateur économique*	*Emploi direct*	*Stimuler les secteurs locaux*	*Stimuler les secteurs locaux*	*Acheter de l'énergie locale*	*Attirer des capitaux/exportations nettes*	*Acheter de l'énergie locale*
Opposé	*Aligné ou Opposé?*	*Aligné ou Opposé?*	*Aligné*	*Aligné*	*Aligné*	*Aligné*	*Aligné*	*Opposé*



LEAP results page showing the rice husk briquette to energy results. Results indicate that utilizing 15 – 25% of the amount of rice husk available at small rice mills for conversion to briquettes to replace charcoal in households, businesses and utilities will prevent the burning of over 3 million cubic meters of wood by 2050.



	2010	2015	2020	2025	2030	2035	2040	2045	2050
Reduced emissions with scenario	0	0	269	794	1596	1947	2342	2782	3267
Non Energy emission with scenario	2290	2712	3371	4008	4646	5284	5922	6560	7198
Transformation emissions with scenario	2337	2836	3028	2945	2569	2680	2753	2789	2790
Demand emission with scenario	226	271	325	457	629	751	884	1027	1180
Emission BAU	4853	5819	6993	8204	9440	10662	11901	13158	14435

Years

3.2.1.3 Key Activities Accomplished in the Democratic Republic of the Congo

The DRC's NDC objectives include increasing renewable energy contributions to cooking fuel use. This objective can be met using several actions, including the promotion and use of modern biogas and biomass briquettes. The government has prioritised the distribution of improved cookstoves to over one million homes (with 50% of those distributed stoves in urban and semi-urban areas) as a key action towards achieving this NDC objective. In addition, the DRC seeks to ensure universal modern energy service access.

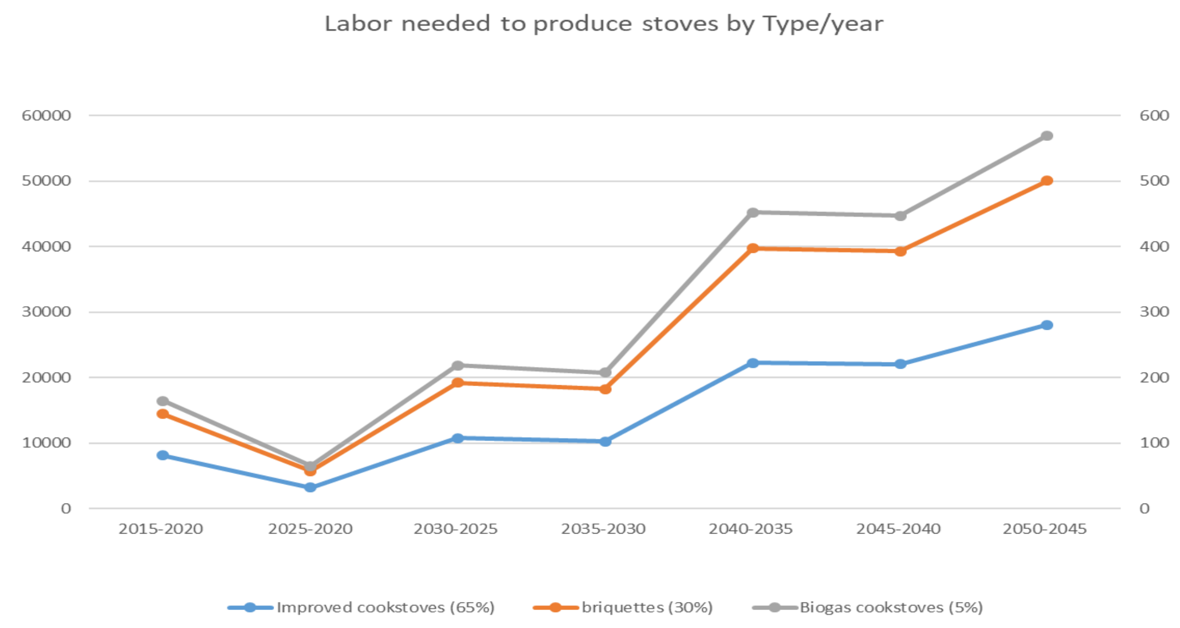
The DRC LEDS team modelled four different policy options by building on the field demonstrations and analysis presented in Section 3.1 focused on cooking fuels, improved stoves and biogas for cooking. These included a business as usual scenario, a government intervention scenario (with subsidized technology implementation), an additional intervention scenario (government interventions start earlier), and a strong economic growth scenario (with an annual GDP growth of 5.3 to 10.2%). The team used the Model for Assessment of Energy Demand (MAED) to identify and highlight energy transition scenarios. The work of the LEDS team demonstrated the socio-economic benefits (job creation, see figure below) of improved cooking fuels and stoves to support the country's broader energy transition. The team also modelled the resulting environmental benefits.

The following is a breakdown of additional activities that were undertaken in the modelling work:

Activity	Sub-activities
Enhancing MAED model to forecast impact of different waste-to-energy scenarios for NDC implementation.	- Updating the GHG inventory and establishment of a GHG emissions baseline. - Modelling the transition to low-carbon energy options in the domestic sector. - Organization of a one-week course for policy stakeholders and institutions on LEDS modelling and GHG inventories. - Working session to share and validate the results of the modelling exercise on the energy demand side and development of scenarios.
Linking models to policy decision making structures.	- Establishing the Inter-institutional Consultative Expert Working Group on Energy Policies and Strategies and Implementation of the Low Carbon Development Strategy. - Workshop to demonstrate model runs with this policy team.
Training policy makers on use of the enhanced MAED model.	- Facilitation and logistics for training workshop (3 days) by country modelling team for policy actors on the use of the enhanced MAED model for NDC actions prioritisation, LEDS modelling, GHG

Activity	Sub-activities
	inventories and a process of establishing emissions baseline for DRC

Model Development and Testing Screenshots. Screenshot of the MAED run on jobs created per year, if government encourages and subsidizes the use of clean domestic energy options demonstrated under Component 1. This shows the effect of the improved stoves and clean technologies such as charcoal substitution as well as the penetration of biogas into the energy balance for domestic cooking needs.



3.3 Component 2-only Countries

3.3.1 Key Activities Accomplished in Ghana

The Ghana LEDS modelling team focused on cookstoves and agroforestry as priority areas of analysis to support updates to the country's NDC. The work demonstrated that the NDC priorities in domestic energy, forestry, agriculture and land-use could be maximised for both climate and socioeconomic benefits through an increased market uptake of clean cookstoves fired by renewable biomass. As opposed to more traditional mitigation approaches of focusing only on the clean cookstoves component.

The LEAP model was used for cookstove technology modelling. The study focused on impacts of increased adoption of improved cookstoves complemented by plantation forestry to serve as the source of fuel. The modelling assessed socio-economic impacts and net GHG reduction potential.

The REDD Abacus model was used to evaluate the climate and socio-economic impacts of forest/wood-fuel plantations as an alternative to converting open forest to grassland for grazing. The wood fuel plantation analysis targeted degraded areas in the transitional ecological zones of Ghana. The modelling evaluated emissions, removals, and opportunity costs associated with changing the land-cover of degraded areas into wood fuel plantations. The modelling team found that grassland-plantation conversions have negative opportunity cost and that an open forest-plantation conversion would provide greater reductions in emissions and a positive net present value. There are potentially additional benefits, if the renewable wood from the wood fuel plantation is used in the improved cookstoves, as the renewable wood replaces the non-renewable wood.

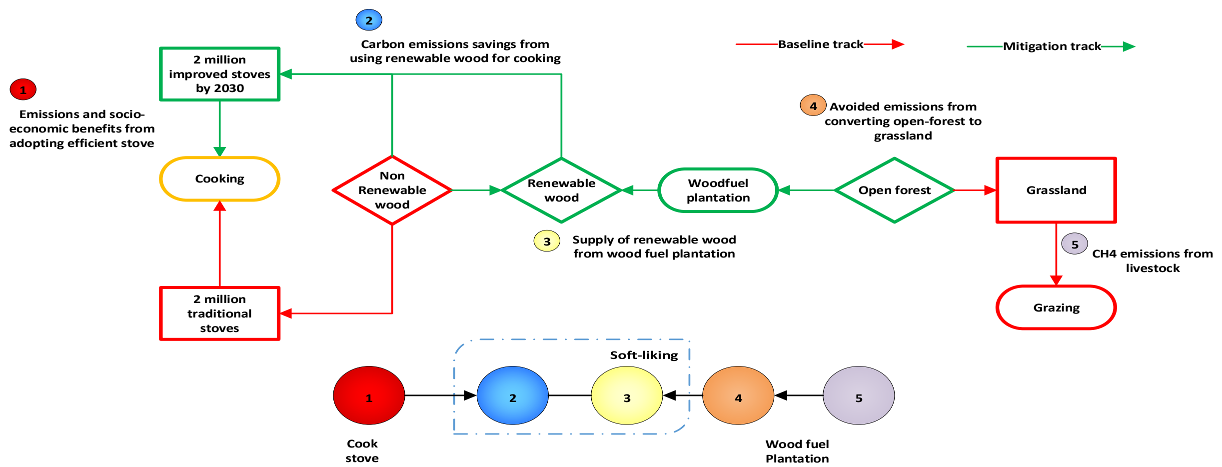
The modelling team also soft-linked the two analyses and models to explore cross-sector benefits of improved cookstove and agroforestry technologies.

The following is a breakdown of additional activities that were undertaken in the modelling work:

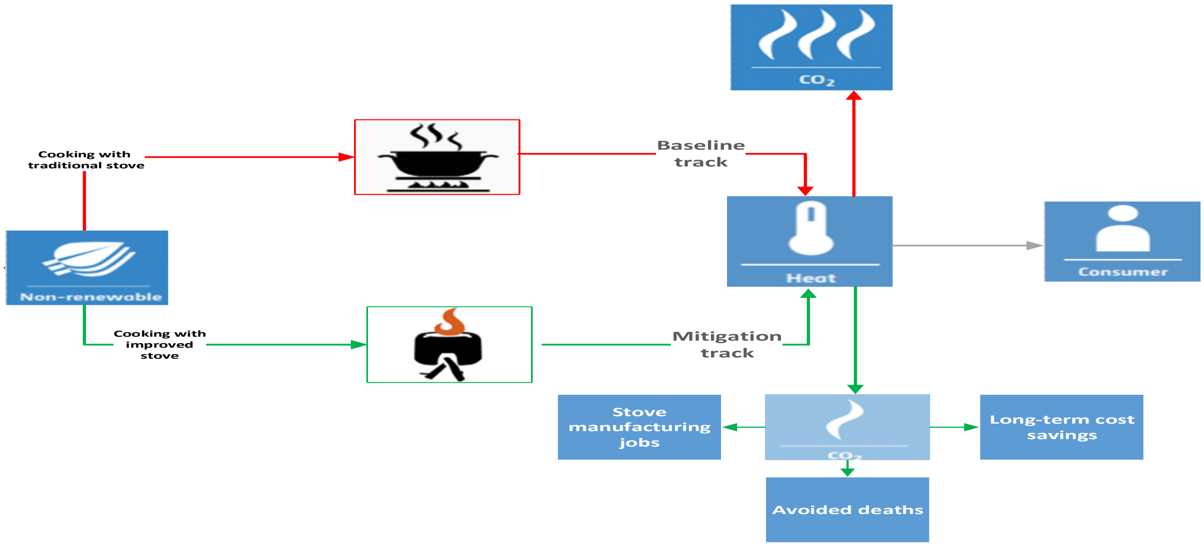
Activity	**Sub-activities**
Establishment of modelling baseline.	- Data Collection and Collation. - Data entry and initial run of the Abacus and LEAP models.
Capacity-building on model integration.	- Modelling team trainings on modifying and using LEAP-IBC and Abacus. - Trainings on soft-linking LEAP and Abacus.
Development of an integrated model framework to inform NDC implementation in the country.	- Hands-on modelling demonstration on soft-linking LEAP and Abacus. - Test running prototype.

Activity	Sub-activities
	- Documentation of initial results and internal expert review. - Model validation by policy and technical actors in the ministry (eventual model users). - Incorporation of feedback from validation runs and final model run.
Incorporation of models to policy decision structure to inform the next round of Ghana's NDC revisions.	- Synthesizing the key results into messages for dissemination to ministries. - Final workshop to launch model and hand over tool to policy makers responsible for environment, energy, forestry, and agriculture.

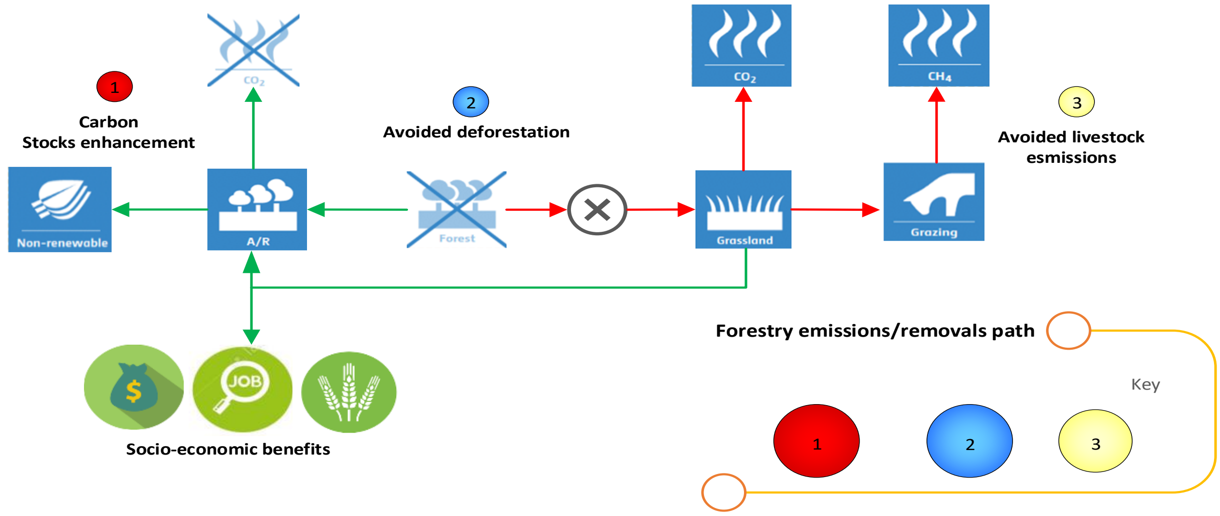
Model Development and Testing Screenshots. Model workflow: soft linking. The following sequence of four diagrams illustrates the Ghana integrated modelling system. A table also follows these diagrams which shows sample results.



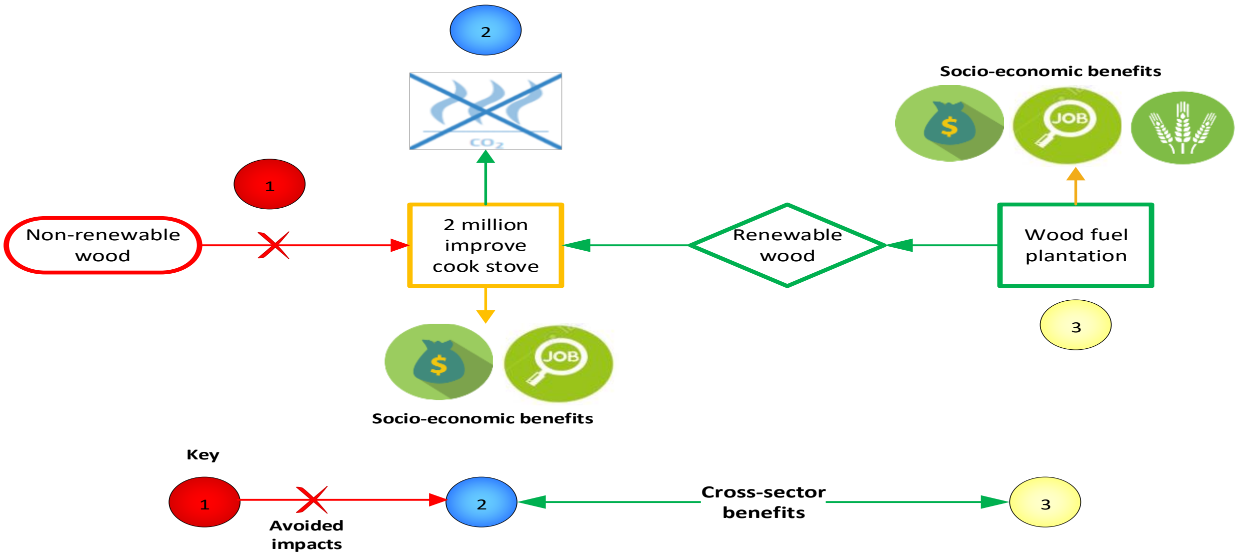
Model workflow: overall approach



Model workflow: cookstove



Model workflow: wood fuel plantation



Year	GHG emissions				Jobs creation		Investments	Health
	Improved cookstove replacement	Establishment of biomass plantation on grassland	Renewable biomass for cooking	Totals	Cookstove replacement	Establishment of biomass plantation		Cookstove replaceme nt
	CO_2e	CO_2	CO_2e	CO_2e	Numbers		Savings ($)	Avoided death
2016	24,061.14	2,769,840.00	151,025.21	2,944,926.35	457.80	53,750	6,375,908	32.40
2017	29,596.77	2,769,840.00	301,290.44	3,100,727.21	560.72	107,500	7,857,259	37.81
2018	30,259.17	2,769,840.00	450,780.47	3,250,879.64	570.81	161,250	8,048,048	43.21
2019	30,934.37	2,769,840.00	599,520.64	3,400,295.01	581.08	215,000	8,242,641	48.61
2020	31,624.28	2,769,840.00	747,500.83	3,548,965.11	591.56	268,750	8,441,758	54.01
2021	32,309.66	2,769,840.00	894,690.63	3,696,840.29	601.83	322,500	8,640,478	66.13
2022	33,006.53	2,769,840.00	1,041,145.77	3,843,992.30	612.27	376,250	8,842,673	78.25
2023	33,716.80	2,769,840.00	1,186,840.92	3,990,397.72	622.88	430,000	9,049,073	90.37
2024	34,442.49	2,769,840.00	1,331,730.48	4,136,012.97	633.65	483,750	9,260,455	102.49
2025	35,180.01	2,769,840.00	1,475,900.58	4,280,920.59	644.59	537,500	9,475,440	114.61
2026	35,918.17	2,769,840.00	1,619,310.69	4,425,068.86	655.46	591,250	9,691,237	126.73
2027	36,671.31	2,769,840.00	1,761,900.02	4,568,411.33	666.48	645,000	9,911,954	138.85
2028	37,435.66	2,769,840.00	1,903,785.08	4,711,060.75	677.66	698,750	10,136,127	150.98
2029	38,213.24	2,769,840.00	2,044,910.16	4,852,963.40	689.00	752,500	10,364,544	163.10
2030	39,012.31	2,769,840.00	2,184,971.25	4,993,823.56	700.49	806,250	10,600,439	175.22

The results table above indicates cumulative climate and socioeconomic benefits of investing in 2 million improved cookstoves powered by renewable wood towards converting 12,000 ha per annum of degraded area to wood plantations. Calculated by LEAP and Abacus soft linking. Emission savings are nearly 60 million tCO_2e by 2030; revenues: US$ 135 million at US$ 9 million annual average; direct jobs: 6,459,266 (manufacture of the improved cookstoves and the establishment wood fuel plantations); avoided deaths: 1,423 deaths due reduced indoor pollution.

3.3.2 Key Activities Accomplished in Kenya

Based on NDC priorities, the Kenya Africa LEDS team chose two priority sectors for analysis: clean cooking solutions and modelling agroforestry.

Biomass is the dominant energy source in Kenya, especially for cooking. The team modelled four different policy scenarios that affect cooking fuel sourcing: a BAU scenario; an improved energy efficiency scenario (the distribution of improved biomass stoves, efficient charcoal conversion kilns); an energy transition scenario (to liquified petroleum gas, ethanol, and other clean fuels); and a combination scenario (energy efficiency and energy transition scenarios combined). The models looked at the environmental benefits (GHG mitigation, forest sink preservation, pollutant mitigation) and the socio-economic benefits (family income, employment, health, and livelihood) from each scenario. The LEAP tool was the principal model used to evaluate the clean cooking scenarios, with the LEAP Integrated Benefits Calculator (LEAP-IBC) add-on used to assess health and fuel expenditures. In addition, the team used I-JEDI to determine related employment and macro-economic benefits of the transition through direct, indirect, and induced impacts.

The modelling team compared the benefits of three scenarios of agroforestry in Kenya using the REDD-Abacus tool: business as usual, implementation of the 2009 rule, and implementation of the NCCAP 2018-2022 agroforestry interventions. The team also completed a cost-benefit analysis for each scenario.

To support the analyses highlighted above, NREL provided an in-depth in-country workshop over the course of four days, which included introductory training on existing IPCCC GHG inventory software, the System for Land-based Emissions Estimation in Kenya (SLEEK) system for estimating land-use, and I-JEDI for macro-economic impact analysis. The second half of the training focused on in-depth training and building capacity with LEAP software, including model theory and limitations, scenario development, and interactive demonstrations of LEAP with hands-on deep-dive exercises. Following this in-person workshop, NREL provided remote technical assistance and support to guide scenario development, data needs identification and acquisition, and build-out of the clean cookstoves model in LEAP. Further, NREL provided a framework through I-JEDI to guide the modelling team's efforts to evaluate job and macro-economic impacts of cookstove adoption.

A second workshop, led by experts from the Stockholm Environment Institute (SEI), expanded upon the clean cookstove scenarios built in LEAP to verify and obtain further final results. The LEDS modelling team included 15 members representing the Kenya Climate Change Directorate (under the Ministry of Environment and Forestry), the Ministry of Energy and Petroleum, the Kenya Forest Service, the Kenya Forestry Research Institute, the Department of Resource Surveys and Remote Sensing, the Jomo Kenyatta University of Agriculture and Technology's Institute of Energy and Environmental Technology, and the Stockholm Environment Institute in Nairobi.

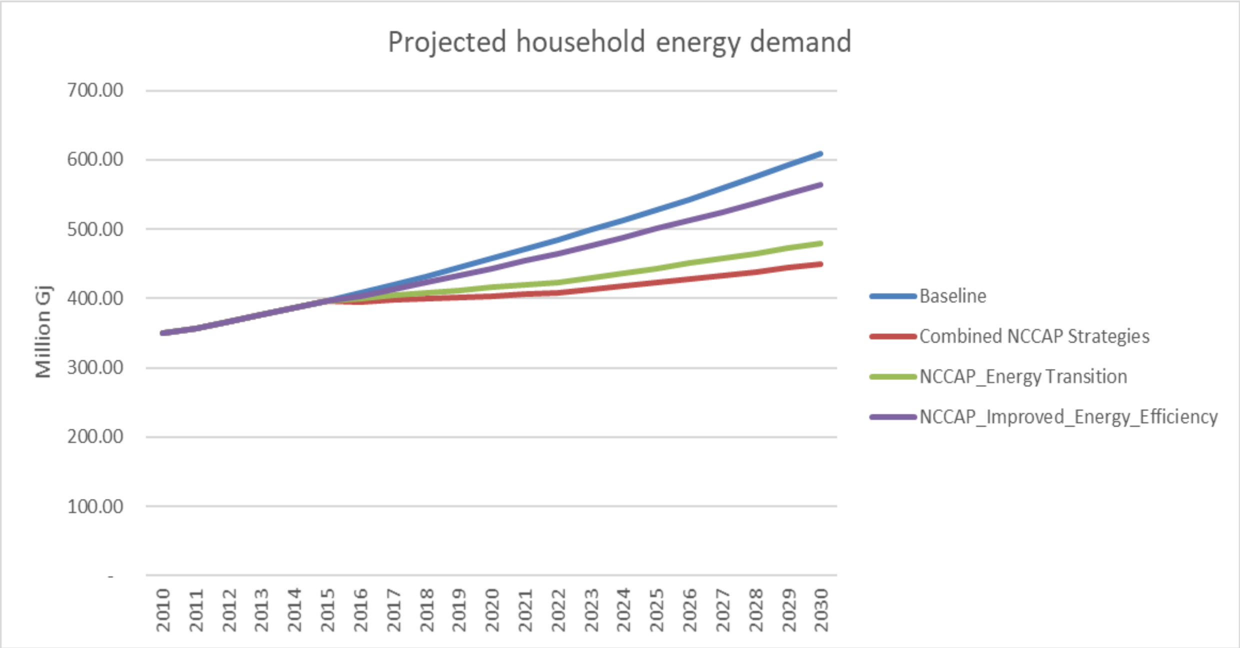
The following is a breakdown of additional activities undertaken:

Activity	Sub-activities
Mobilize modelling team to identify possible models.	- Identify technical and policy actors in relevant ministries - environment, forestry, energy, agriculture to form modelling team. - Organize 1day workshop for in-country modelling team to identify project level priorities within the AFOLU and energy sectors that will be the focus of enhanced modelling and analysis support.

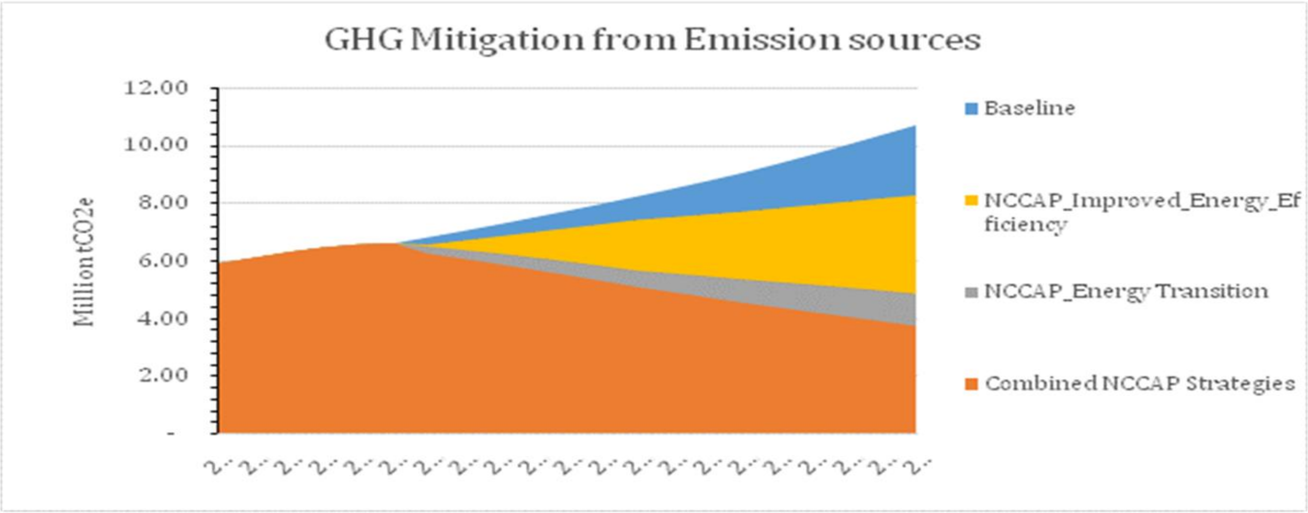
Activity	Sub-activities
Capacity enhancement for country modelling team.	Organized 4-day workshop for: - Stocktaking of existing models being used across Kenyan institutions and organizations for suitability analysis of modelling climate and socioeconomic impacts simultaneously. - Training workshop for country modelling team on LEDS modelling and updating GHG/NDC baseline.
Model selection and testing.	Organized – 3-day workshop for: - Test running shortlisted models and reviewing output parameters. - Finalizing selection of specific models to be used/adapted.
Data generation and model calibration.	- Desk studies to establish data sources, compile and organize data. - 3-day hands-on workshop with technical modelling team focused on applying the selected models within each priority activity/subsector.
Adapt and test model options relevant to long term LEDS planning in line with Kenya`s economic priorities.	- 3-day workshop to establish Kenya's project level baseline for improved cook stoves in domestic and commercial uses, and Agroforestry vis-à-vis BAU scenarios. - 4-day workshop to adapt and test models on carbon offset; percentage of GDP added; jobs created; cost saving / income increased by alternative project level investment trajectories of chosen priorities - improved cook stoves in domestic and commercial uses and Agroforestry vis-à-vis a BAU scenario of biomass/firewood, kerosene and normal agricultural practices. - Calibrate, transfer and installation of adapted models(s) in decision frameworks of technical and policy departments in relevant line Ministries

Model Development and Testing Screenshots

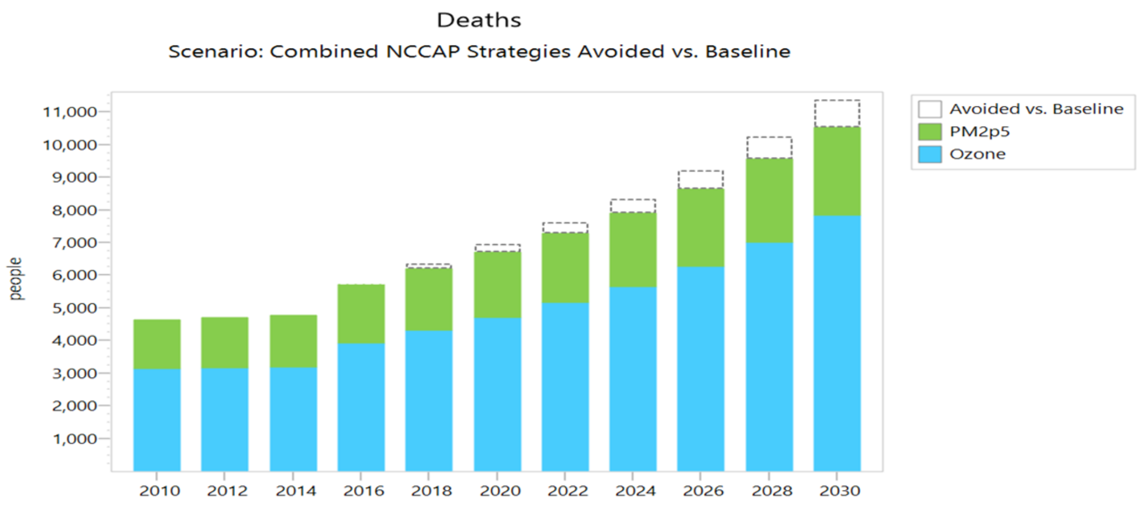
Screenshot of LEAP runs showing energy savings of switching to clean cookstoves as recommended by the National Climate Change Action Plan (NCCAP). About 7%, 21% and 26% of final energy will be saved from the baseline in deploying energy efficiency measures, transition to LPG, and combined efficiency and transition scenarios, respectively.



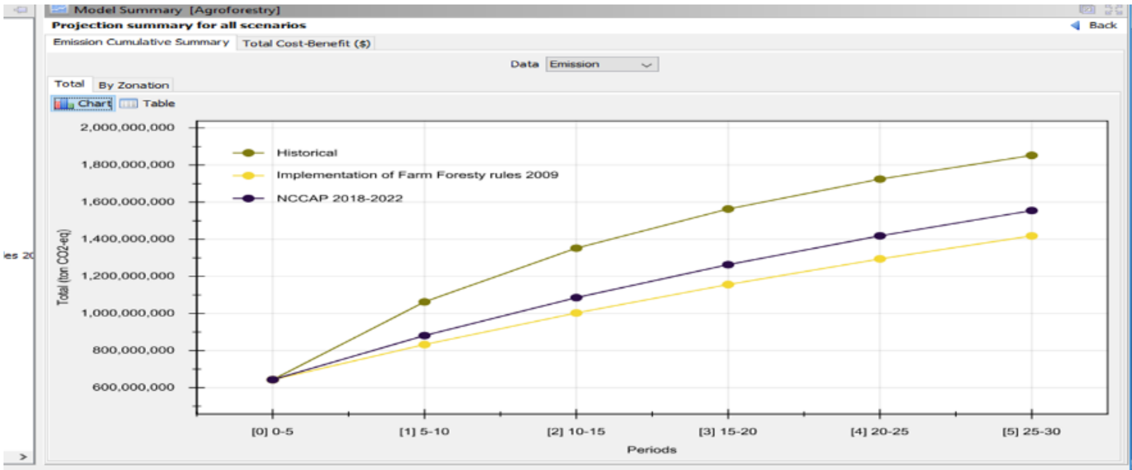
Screenshot of LEAP run showing clean cooking mitigation action results. These include reductions of about 2.6 million tCO_2e and 7 million tCO_2e in 2022 and 2030, respectively in the combined mitigation strategies. These reductions would help the country towards achieving its NDC. This will meet the NCCAP target to reduce emissions by 6.09 $MtCO_2e$ by 2030.



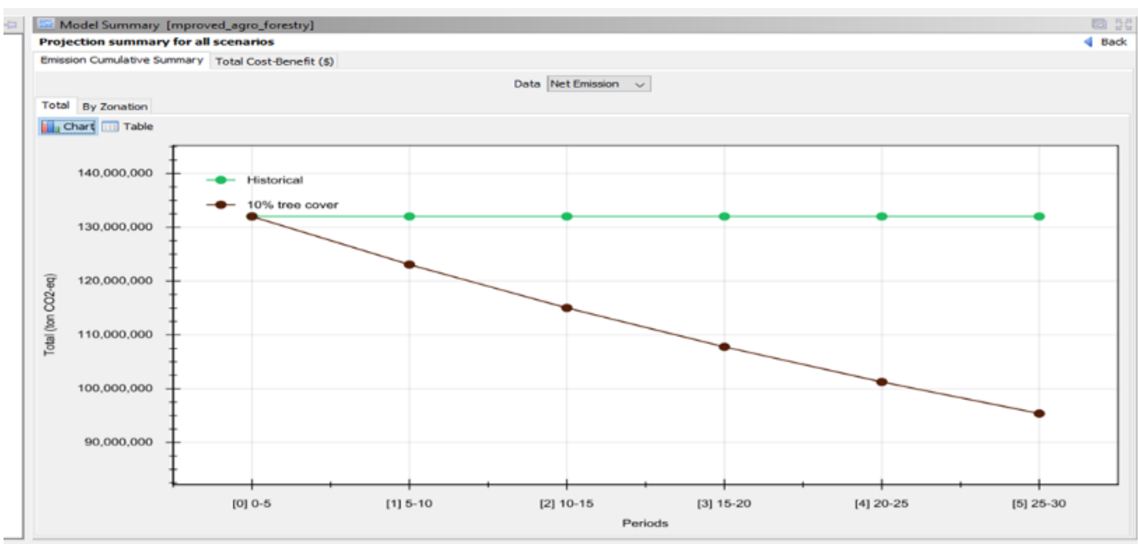
Screenshot of LEAP-IBC run showing impact of limited action of reducing dependency on solid biomass for cooking. This would result in the annual prevention of about 337 deaths in 2022 and 848 deaths in 2030.



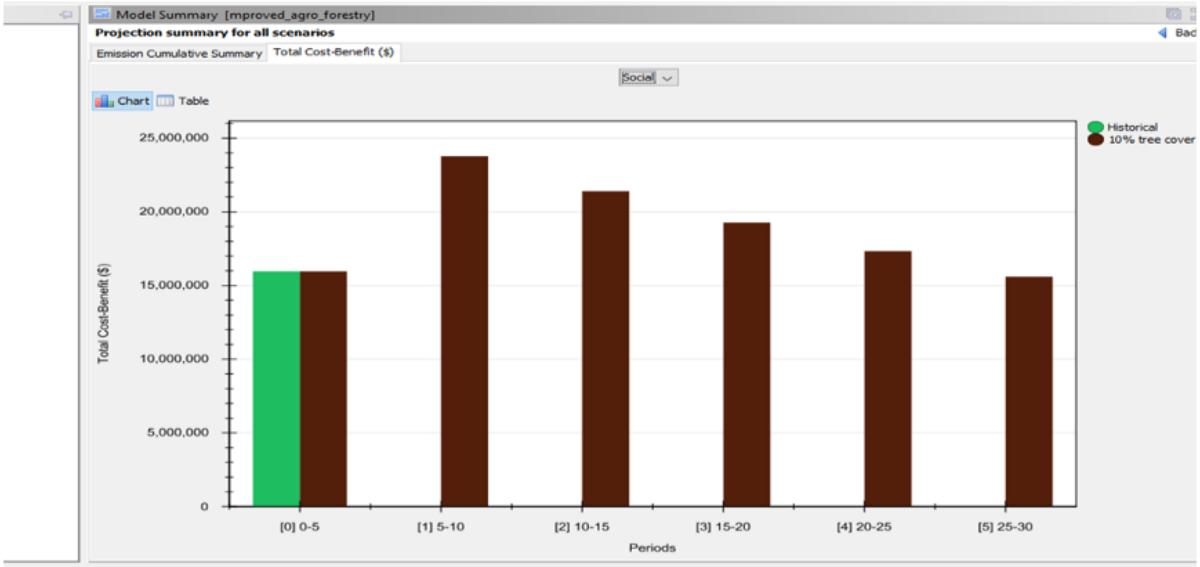
Screenshot of REDD-Abacus run. This result shows that enhancing agroforestry in implementing the Farm Forest Policy 2009 will abate 434 $MtCO_2e$ by 2044. Implementation of NCCAP has abatement potential of 297 MtCO2e over the same period – meaning the forest policy 2009 will have a greater impact in increasing Kenya's forest sinks.



Another Screenshot of REDD Abacus. This run shows that enhancing agroforestry approaches will reduce emissions from 132 $MtCO_2e$ to 95 $MtCO_2e$ in a period of 30 years as compared to BAU slash and burn agricultural practices.



Screenshot of an I-JEDI run showing cost-benefits of enhancing agroforestry approaches. The cost benefits will increase from about $16 million dollars to $24 million dollars in the first 5-10 years.



3.3.4 Key Activities Accomplished in Mozambique

Mozambique prioritized sustainable agriculture, specifically clean energy irrigation and agroforestry, as areas of analysis to inform the country's NDC. LEAP was used for energy modelling actions and REDD-Abacus was used for agriculture and land use change modelling.

Irrigation in Mozambique is dominated by fuel powered irrigation (FPI) systems. Solar powered irrigation (SPI) systems are a viable, non-emitting alternative that was explored to catalyse fuel switching investments in the country. In the LEAP modelling, FPI was used as the BAU scenario, and the mitigation scenario focused on SPI.

REDD-Abacus modelling was used for land use change modelling in Mozambique. Slash-and-burn agriculture (SAB) was used as the BAU scenario. An agroforestry system (AFS) was used as the mitigation scenario. Agroforestry reduces net emissions by increasing the land's potential as a carbon sink.

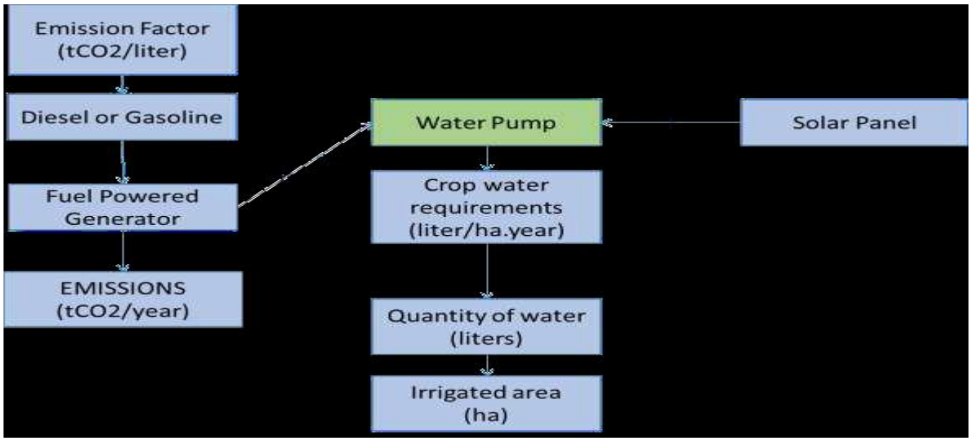
The LEAP and REDD-Abacus models were also soft-linked to determine the cumulative effect of actions that create synergy between the complementary areas of SPI and AFS.

The following is a breakdown of key activities that were undertaken:

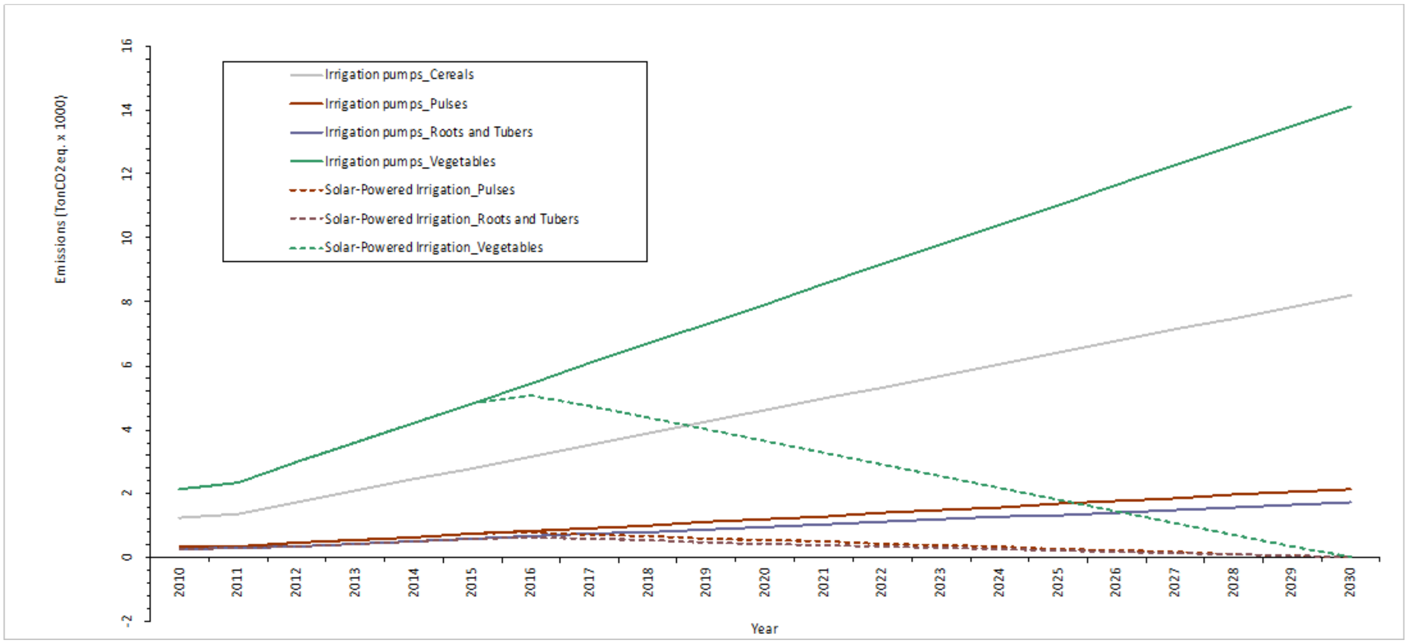
Activity	Sub-activities
Establishment of modelling baseline.	- Data Collection and Collation. -Establishing integrated methodology to build scenarios.
Capacity building on model integration.	- Modelling team trainings on modifying and using LEAP-IBC and Abacus. - Trainings on soft-linking LEAP and Abacus. - Data entry and initial run of the Abacus and LEAP models.
Development of an integrated model framework to inform NDC implementation in the country.	- Hands-on modelling demonstration on soft-linking LEAP and Abacus. - Test running prototype. - Documentation of initial results and internal expert review. - Model validation by policy and technical actors in the ministry (eventual model users). - Incorporation of feedback from validation runs and final model run.
Incorporation of models to policy decision structure to inform the next round of Ghana's NDC revisions.	- Synthesizing the key results into messages for dissemination to ministries. - Final workshop to launch model and hand over tool to policy makers responsible for environment, energy, forestry, and agriculture.

Model Development and Testing Screenshots

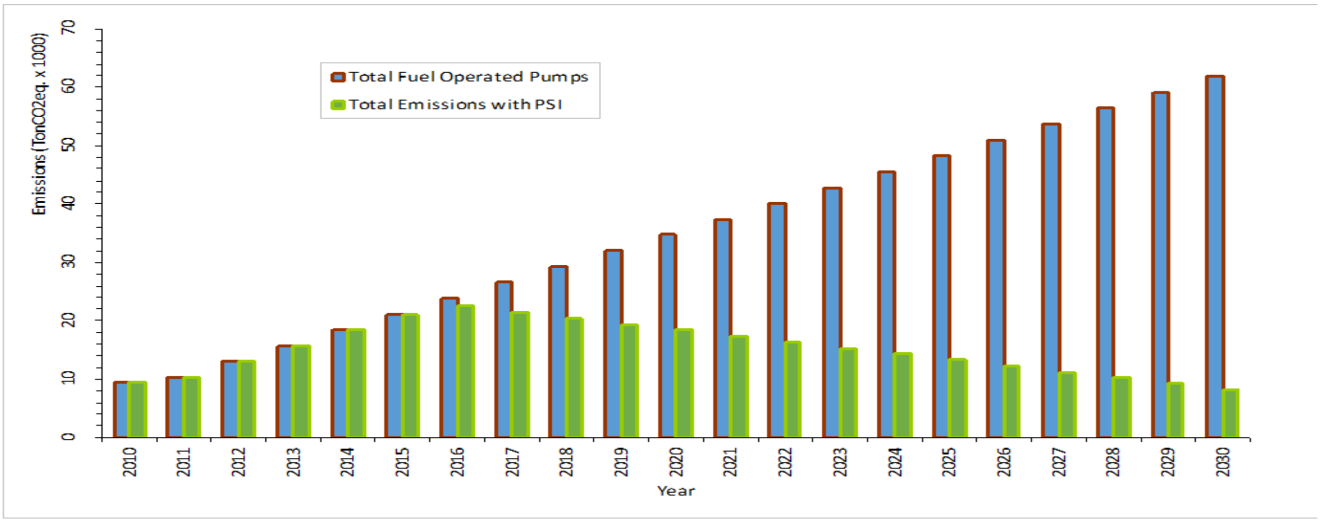
Screenshot of Mozambique integrated model conceptual model



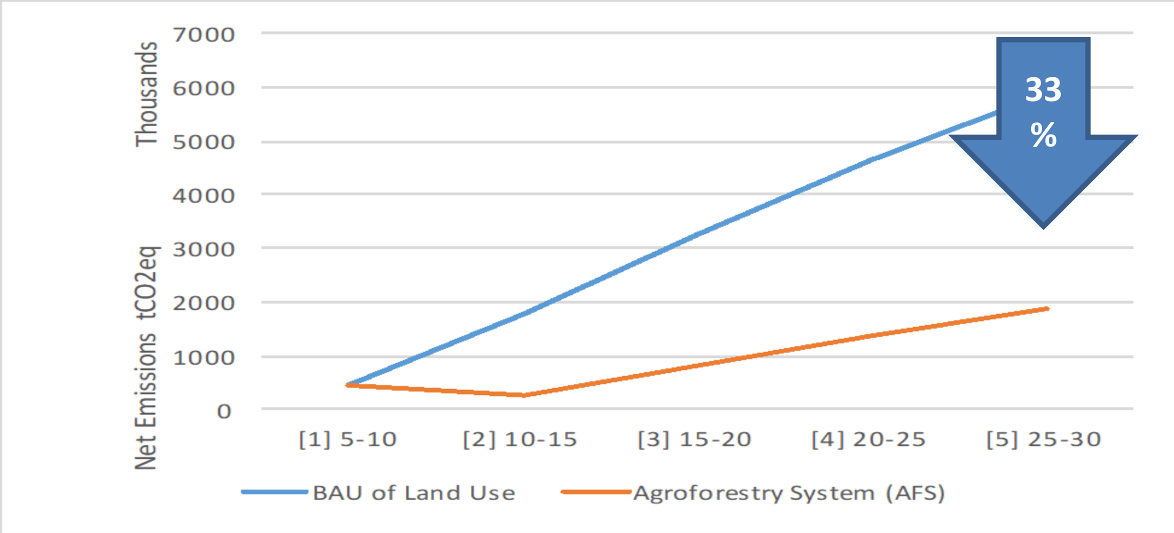
Screenshot of LEAP run net emissions scenario of replacing conventional fossil powered irrigation with solar powered irrigation



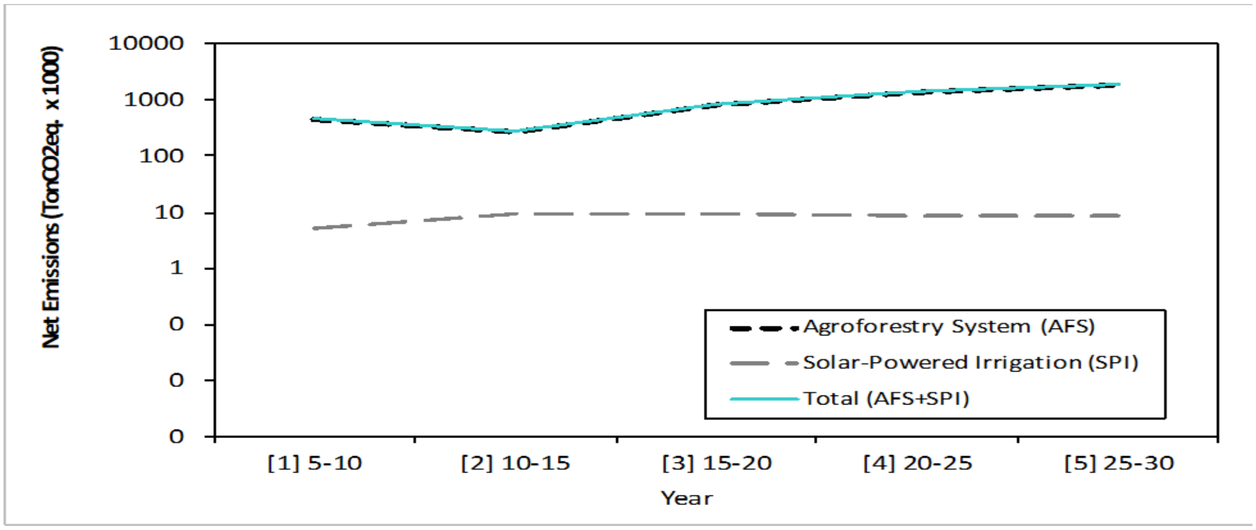
Screenshot of LEAP run total emissions reduction resulting from scaling solar powered micro-irrigation vis-à-vis BAU scenario of fossil fuel powered irrigation



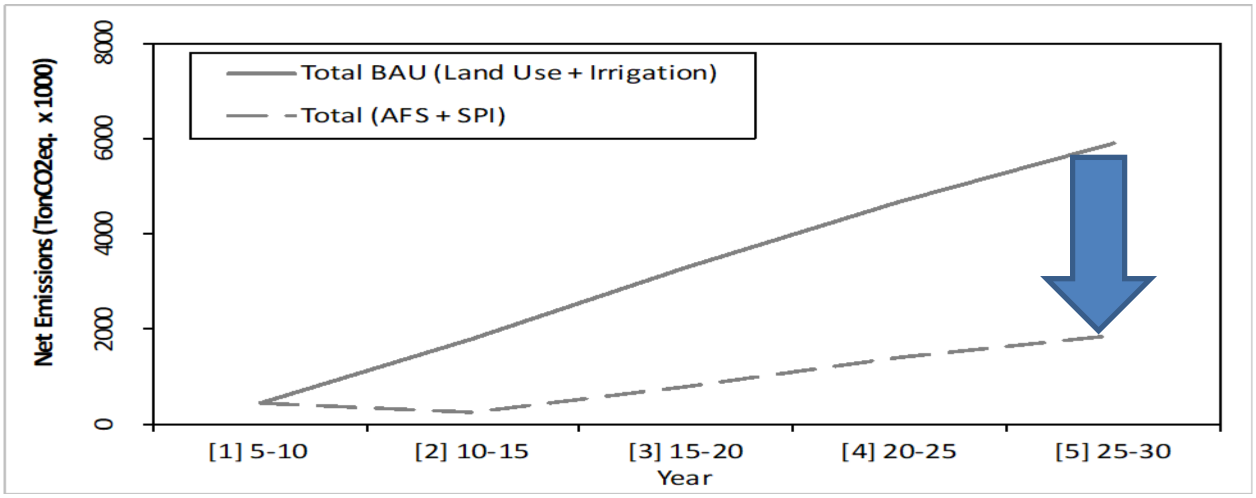
Abacus run net emissions sequestered by scaling agroforestry vis-à-vis BAU land uses of slash and burn agriculture



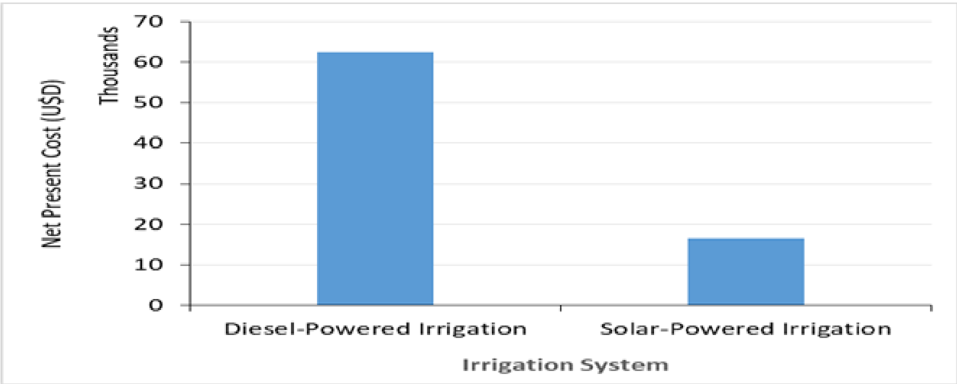
Abacus run total emissions sequestered by amalgamation of agroforestry and solar powered irrigation vis-à-vis BAU of silo agroforestry and solar powered



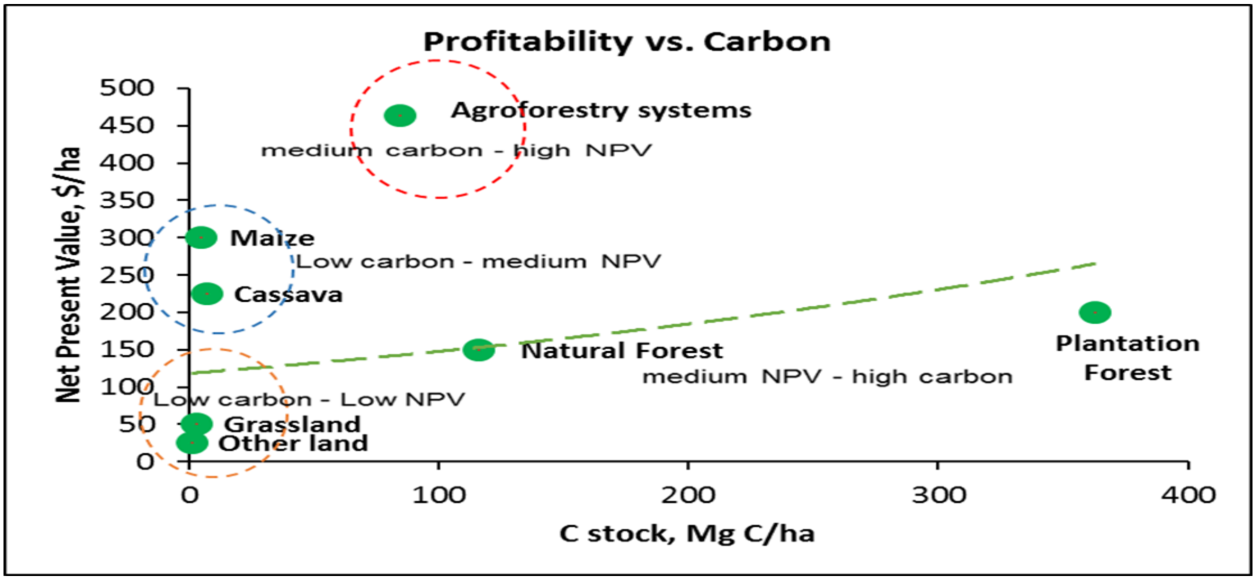
Abacus run on net emissions sequestered by amalgamation scenario. Scaling solar powered micro-irrigation in agroforestry farms vis-à-vis BAU scenario of scaling fossil powered irrigation in slash and burn agriculture.



LEAP run on cost analysis of fossil powered irrigation vis-à-vis solar powered irrigation



Abacus run cluster analysis between profitability and carbon stock amongst different land uses. Socioeconomic return of NPV / profitability against carbon sequestered by converting natural forests into agroforestry vis-à-vis BAU of converting natural forests into conventional slash and burn farms of various crops and control scenario of in-situ natural forests. Agroforestry provides the most profitability return and sequesters the most carbon compared BAU slash/burn cassava and maize farms. Natural forests and plantation forests however sequester the most carbon but have the lowest profitability return compared to agroforestry and BAU slash/burn cassava and maize farms.



3.3.4 Key Activities Accomplished in the Republic of Zambia

The Zambia Africa LEDS Technical Working Group (LEDS-TWG) led analysis of key low carbon actions to support Zambia's NDC: off-grid renewable energy, sustainable agriculture, and natural forest enhancement through natural regeneration. For the energy sector component, the working group selected the implementation of three off-grid hydro projects and two solar mini-grids. The working group utilized International Jobs and Economic Development Impacts (I-JEDI) to determine jobs and economic impacts of solar mini-grids and mini-hydro grids. The group also studied the impacts of replacing firewood with efficient cook-stoves. LEAP modelling was used to determine energy demand trends and the resulting GHG emissions.

The working group dynamically linked the LEAP data with I-JEDI to bring in emissions outputs as well as determine the jobs and economic impacts of cookstove project implementation. This provided a holistic view of both socio-economic and climate indicators of the project actions.

The working group used I-JEDI, which was enhanced to include agroforestry and land use sectors, to find the socio-economic impacts of sustainable agriculture practices in the three project areas.

The working group also utilized Abacus to estimate the amount of GHGs that would be reduced by using the sustainable agriculture practices.

The forest enhancement mitigation work included analysis of the introduction of improved charcoal production kilns as well as agroforestry. These can help enhance assisted natural regeneration (ANR), which is a combination of forest and land use techniques that can be used to restore degraded and deforested lands into more productive forests. The working group studied the types of forests and wood removal for logging, charcoal, and firewood, as well as related GHG emissions due to wood removal from different forest types. The team used I-JEDI to analyse the jobs and economic impacts of forest enhancement and natural regeneration implementation.

In addition to providing an in-country technical training workshop, NREL provided remote technical assistance and support throughout this process to develop an enhanced I-JEDI model dynamically linked with LEAP to bring in emission outputs to provide a holistic view of both socio-economic and climate indicators of the actions in the prioritized energy and AFOLU sectors. The two-day in-country workshop included an introduction to I-JEDI, including model theory and limitations, scenario development, and interactive demonstrations of I-JEDI with hands-on deep-dive exercises. The second day focused on adjusting the model based on collaborative feedback and on translating these initial integrated modelling and analysis results into action, including policy development, implementation activities and mobilizing investment. The LEDS TWG included 20 members representing organizations including MLNR-CCNRMD, MLNR-Forestry Department, MLNR-NDC, CEEEZ, ZIPAR, UNZA, MOE, MOA, ZEMA, NRSC, EMD and ZMD.

Taken as a whole, the actions assessed under this project will inform updates to Zambia's NDC and other complementary policies.

The following is a breakdown of key activities that were undertaken:

Activity	Sub-activities and Related Activities
Mobilize modelling team to identify possible models.	- Identify technical and policy actors in relevant ministries - environment, forestry, energy, agriculture to form a modelling team. - Establish modelling priorities.
Baseline analysis.	- Desk studies to establish data sources, compile and organize sources. - Stocktaking of existing models being used across Zambian institutions and organizations for suitability analysis of modelling climate and socioeconomic impacts simultaneously.
Capacity enhancement for country modelling team.	- Test running shortlisted models and reviewing output parameters. - Finalizing selection of specific models to be used/adapted. - Training workshop for country modelling team on application of chosen models.
Data generation and model calibration.	- Data collection on energy off grid, sustainable agriculture and forest enhancement and regeneration. - Training on applying the selected models (LEAP and I-JEDI) within each priority activity/subsector.
Adapt and test model options relevant to long term LEDS planning in line with Kenya`s economic priorities.	- Development of enhanced I-JEDI (linking LEAP output to I-JEDI). - Calibrate, transfer and installation of adapted models(s) in decision frame works of technical and policy departments in relevant line Ministries.

Model Development and Testing Screenshots

Screenshots linking LEAP to I-JEDI to forecast cumulative socioeconomic benefit of shifting to clean cookstoves

Cookstove Scenario - Zambia

Click for help ?

Country	Zambia		
Dollar Year	2010		
Cookstove Scenario Type	Conventional to efficient		
Will this use the LEAP scenario in the "LEAP-Cookstoves" tab?	Yes - Import LEAP Scenario		
What year would you like to import?	2021		
Cumulative or Annual	Annual		

Click to view LEAP scenario — LEAP

Populate with Defaults

Installation/Single Event		% Manufactured in Zambia	% Purchased or spent in Za
Number of new cookstoves purchased (LEAP)	11		
Cost of new cookstoves ($2010 USD)	$ 1,410	10%	90%
Transportation expenses for cookstoves ($2010 USD)	$ -		0%
Disposal of old cookstoves ($2010 USD)	$ -		0%
Total	$ 1,410		

Ongoing		% spent in Zambia
Annual change in charcoal expenditures ($)	$ (4,375,800)	100%
Change in stove maintenance expenditures	0	100%
Total	$ (4,375,800)	

Click to view results

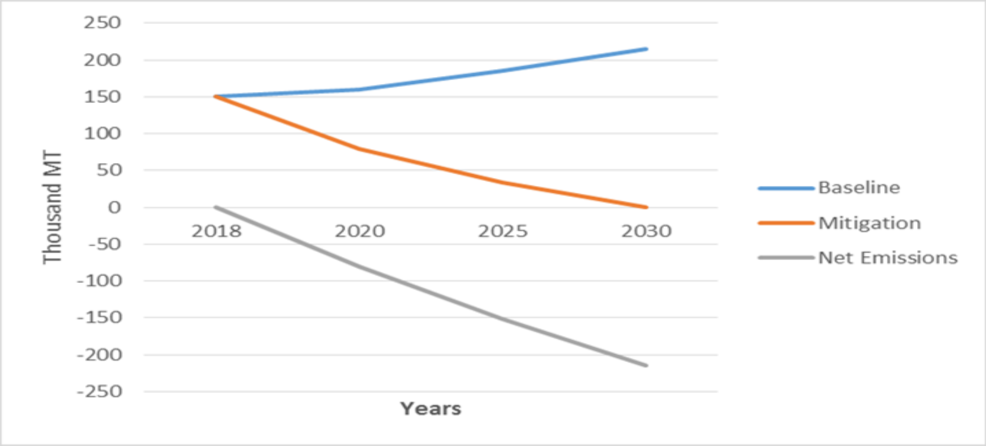
I-JEDI

Variable: Indicators: Indicator (Cookstoves)													
Scenario: Mitigation	If dollars are imported from LEAP I need to know where the dollar year would be listed and the format												
Branch: Indicators\Cumulative Efficient Cook Stoves	< - macro detects if word "efficient" is in this cell; otherwise uses the electric scenario												
Region: Region 1													
Branches	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Annual Added Efficient Cook Stoves	-	23.00	24.00	11.00	12.00	12.00	13.00	14.00	14.00	15.00	16.00	17.00	18.00
Cumulative Efficient Cook Stoves	-	23.00	47.00	58.00	70.00	82.00	95.00	109.00	123.00	138.00	154.00	171.00	189.00

Import LEAP Scenario

LEAP

LEAP emissions reduction potential for shifting to clean energy – cookstoves, and hydro and solar mini-grids



I-JEDI socioeconomic benefits for the hydro and solar mini-grid proposed projects

Project Name	Investment Cost (ZMW)	Size (MW)	Number of Jobs		GDP (ZMW)	
			Construction Phase	O&M Phase	Construction Phase	O&M Phase
Kansanjiku Hydro	98.73m	0.64	1017	106.6	32.7m	2.8m
Zengamina Hydo	35.69m	0.7	311	38.4	10m	1m
Chipota Hydro	17.59m	0.2	40	6.1	1.7	0.2

Project Name	Investment Cost (USD)	Size (MW)	Number of Jobs		GDP (USD)	
			Construction Phase	O&M Phase	Construction Phase	O&M Phase
Lunga PV	.478m	0.3	116	4.7	110,750	3,941
Chunga PV	.4m	0.2	141	3.9	230,262	3,298

Abacus run: agroforestry / assisted natural regeneration emissions reduction potential

Sector	No. of jobs		GHG reduction		
	Implementation	O&M	2020	2025	2030
AFOLU- Forest enhancement and assisted natural regeneration	84	Negligible	-353.1 million tonnes	-298.1 million tonnes	-251.7 million tonnes

Abacus run, results emissions potential of investing in sustainable agriculture including replacing mineral fertiliser with organic fertiliser

Scenario/Year	2017	2020	2025	2030
Baseline emission(Gg)	1.55	1.69	1.94	1.99
Mitigation emission (Gg)	0.14	0.58	0.96	1.08
Total reduction potential	1.14	1.11	0.98	0.91

Socio-economic impacts of investing in sustainable agriculture including switching from mineral fertiliser to organic fertiliser for the 3 project areas

District	Number of jobs	Earnings (US$)	GDP (US$)	Output (US$)
Kalomo	2,094	2,521,628	4,717,628	7,523,998
Petauke	3,889	4,726,009	9,154,009	14,681,584
Mpika	840	1,024,781	1,991,381	3,217,430
Total	6,824	8,272,418	15,863,018	22,205,582

3.4 Key Activities Accomplished on Peer-to-Peer Knowledge-Sharing

Peer exchanges and learning from project lessons was another key activity under the Africa LEDS Project. This activity was aimed at ensuring participating countries learned from each other and project products could be shared to catalyse continent-wide transitions to demand-driven implementation of NDCs. Through these peer exchanges, benefits of work done in the seven project countries is hoped to be replicated across the entire continent for continent-wide scale and lasting impact. Peer exchanges took place on two levels. The first is the AFOLU-focused community of practice (CoP). The second was the project closeout and lessons-sharing meeting. These peer exchanges involved participation of non-partner countries and provided a framework for anchoring project products for replication and upscaling across Africa well beyond the project cycle.

Community of Practice

The CoP was established to ensure project lessons and experiences are shared continentally through a network of regional institutions and partner activities. These focus on learning in three dimensions: modelling methods and tools selection and capacity-building; linking LEDS policy design and cost-benefits analysis across non-energy (agriculture, forestry and waste management) and non-energy (e.g. small-scale energy solutions); and application of modelling to inform national policies.

CoP sessions started in 2018 by bringing together the seven project countries (Cameroon, Côte d'Ivoire, DRC, Ghana, Kenya, Mozambique and Zambia) to share their experiences and benefit from additional experiences and lessons on low emissions development from established networks across the continent, specifically the Africa LEDS Partnership (AfLP). As many of the Africa LEDS Project countries focused on AFOLU sectors for demonstration projects and modelling, as well as links across the agriculture and energy sector, AFOLU was chosen as the area of emphasis for the CoP. Several exchanges described below were facilitated through interactive online sessions.

The first interactive online peer learning session was conducted on 26th April 2018. The focus was on novel approaches to support linked analysis and modelling for catalytic climate action that maximizes both climate and socioeconomic aims. The session highlighted work in Mozambique, under the Africa LEDS Project, to link the LEAP and Abacus models for integrated assessment of key climate actions. The session also included an overview of global resources to support AFOLU analysis to enable climate and socioeconomic objectives. The session concluded with an interactive discussion across project partners.

Building on this session, Mozambique became a peer learning partner with Ghana to share further insights and guidance related to linking LEAP and Abacus, as both countries pursued similar approaches.

The second peer learning session, held on 28th June 2018, focused on use of the I-JEDI model to support development-driven action in the AFOLU and energy sectors. The session featured presentations by Zambia and NREL on use of the I-JEDI model for this purpose, as well as a targeted interactive discussion.

The third peer learning session, held on 25th July 2018, focused on linking small-scale energy and agriculture to support development and climate goals. Specific topics covered include LEDS small scale irrigation and scaling up smallholder solar irrigation in Sub-Saharan Africa, refining and building on Mozambique as a case study, and rice husk briquettes for cooking fuel building on and refining developments in Côte d'Ivoire.

A fourth peer learning session, held on 30th August 2018, was focused on agroforestry. Kenya was engaged as an expert speaker to share lessons and experiences with agroforestry modelling as a result of work being supported jointly by the Africa LEDS project and the US Department of State Compact. A representative from the Kenya Forestry Service presented Kenya's experience on agroforestry intervention and related ongoing analysis. This provided a good basis to cross-hybridise with Mozambique experiences in modelling agroforestry using Abacus.

Several resources were developed to support the CoP including a presentation for the CoP overall, detailed technical presentations for each session, a broader peer learning plan, and a distribution list and member survey, managed by the Africa LEDS Partnership. For all CoP session recordings and presentations please visit: http://ledsgp.org/2018/04/africa-afolu-community-practice/ .

All sessions were facilitated via webinar. One peer learning champion institution – Eduardo Mondlane University (EMU) in Mozambique – was chosen to be the hub of these peer exchanges that will continue well beyond the end of the project cycle and this will ensure the uptake of project results and sustainability of the Africa LEDS planning capacity across the continent.

The Project Experience and Lessons Sharing Meeting in Accra

The project closeout meeting, organised on 30 – 31st May in Accra, Ghana, featured participation of state and non-state stakeholders from four non-partner countries – Benin, Nigeria, Togo, and Uganda. This two-day event provided a platform for the seven project partner countries to share what the Africa LEDS project achieved in their respective countries and the lessons for optimal NDCs implementation they gathered from the project. The engagement concluded with adoption of a declaration: "the Accra Action Agenda on Low Emissions Development Strategies (LEDS) For Africa". This declaration urges governments in Africa to create an enabling environment for low emissions development strategies uptake, leveraging on the need for strategic implementation of NDCs as demonstrated in the project. The declaration is set for presentation to ministers at the 17th ordinary session of the Africa Ministerial Conference on the Environment (AMCEN) to unlock high-level policy endorsement for continental upscaling of project lessons well into the future.

4. Implementation of the Visibility and Communication Plan

Throughout the project period, lessons, outcomes and impacts were continually shared on both virtual platforms, through social media and the project website, as well as physically through participation in global and continental forums on environment and low emission development. Successes gleaned from this project were used to make a case to convince ministers to endorse policy positions towards premising environment as a solution to achieve socioeconomic growth. The result was the adoption of a relevant high-level decision on Innovative Environmental Solutions at the 3rd UN Environment Assembly (UNEA 3) in December 2017 and adoption of instruments to implement climate action as an accelerator of socioeconomic transformation in Africa at the 7th Special Session of the Africa Ministerial Conference on the Environment (AMCEN) in September 2018. In addition, lessons were shared at a continental multi-stakeholder conference on low emissions development – the 2018 African Carbon Forum in April 2018.

A further demonstration of visibility was achieved at the Accra close out meeting. Proceedings, including adoption of the "the Accra Action Agenda on Low Emissions Development Strategies (LEDS) For Africa" were covered by multiple third-party online media outlets with a continental appeal and audience. A critical part of the communication was also aimed at informing the public of the implementation support structure of this work. This was achieved through use of placards erected at the sites where the ground demonstration actions were undertaken.

5. Africa LEDs Project Testimonials from Countries

At the national level, testimonials from policy makers on the project benefits further enhanced visibility of project achievements at decision maker level. Among testimonials were as follows:

Cameroon

Mr HELLE Pierre, Minister of the Environment, Nature Conservation and Sustainable Development said "*The EC-UNEP Africa LEDS project was for us an opportunity to concretize Cameroon's commitment through the implementation of its CDN. It made it possible to use concrete examples from the field to illustrate the impacts of a responsible climate policy. It was also the opportunity to set up a task force for low-emission development in Cameroon, with the various ministerial departments and public and private institutions concerned. We sincerely thank this initiative, which leaves the country with a tool for monitoring the greening and digitization of environmental policies."*

Ing. WAGNOU Valentin, Inspector N°1 MINEPDED said *"Ministry of Environment, Nature Protection and Sustainable Development (MINEPDED) will play its full role in ensuring that each sector takes ownership of the results of the LEDS project, particularly the energy, agriculture, transport and ICT sectors. It is crucial for us to take ownership of LEDS models and modelling tools in order to focus our decisions on facts."*

Prof. AMOUGOU Joseph, Director National Observatory on Climate Change (ONACC) said "*The LEDS project, in its entirety, allowed ONACC to see clearly how the Paris Agreement through the Cameroon NDC could be implemented in a concrete way. The intelligent aspect of the model developed will not only allow to analyse the impacts on GDP, employment, investments and greenhouse gas emissions, but also to make systematic forecasts through the collected data as instrument for decision making. Hence there is a clear need to develop a national strategy for collecting climate sector data that could be one of ONACC's main areas of work."*

Côte d'Ivoire

Prof Joseph Séka SEKA, Minister of the Environment and Sustainable Development said *"The EC-UNEP Africa LEDS project, provided us with the opportunity to understand how we can practically implement our NDCs in a way that lowers emissions and creates socioeconomic opportunities for our country. By this, it provides the full package of building climate resilience covering both socioeconomic and environmental/ climate aspects. We are going to build on the great outcomes we achieved to ensure that we implement climate actions within an informed policy trajectory that informs maximized investments – all thanks to the analytical tool and the practical case studies this project has helped develop for our country."*

Dr Eric ASSAMOI, Director of the fight against climate change said *"LEDS project, in its conception was for us, a great asset, a first approach in the implementation of the NDC, because it allowed us finally to* *design our NDC in a concrete and well-structured project in the case of pilot project that has implemented in the rice sector. So, for us, it's to see how we could design our NDC into projects that could eventually be scaled up."*

Mr. KOYA Jean Claude, Technical Advisor to the Minister of Planning and Development in charge of environmental issues and sustainable development said *"The Ministry of Planning as the Ministry in charge of national planning through the definition of the national development plan, the national prospective study and the national statistics, will play its full role so that each sector appropriates the results of the LEDS project in particular the sectors of energy, agriculture and industry. It is for us to capitalize not only the LEDS modelling models and tools but the integrated ones in the body of national governance tools."*

Ghana

Ag. Executive Director, Environmental Protection Agency said "*The aim of the project is to establish an analytical framework to facilitate long-term LEDS policy decision making and implementation consistent with Ghana's climate objectives and socio*-economic *development priorities as stipulated in the GH-NDCs and other LEDS plans."*

Kenya

Augustine Kenduiwo, Deputy Director in charge of Climate Change, Ministry of Environment and Forestry said *"Climate action and socioeconomic development seem to be difficult to achieve simultaneously – but through this project, Kenya is set to leverage implementation of its NDCs as an enabler of its socioeconomic priorities – the Vision 2030 and its derivatives like the Big 4. This will be highly valuable as we prepare to submit second round NDC commitments. We thank the EC and UNEP for their support and look forward to full uptake of this project products going forward."*

Zambia

Honourable Jean Kapata, M.P, Minister of Lands and Natural Resources said *"The results serve as a guide on what climate mitigation actions can be implemented to support the Zambia Nationally Determined Contribution and where socio-economic benefits can be derived."*

6. Conclusion

This project demonstrated four key lessons to inform optimal NDC implementation on the continent:

- First, with the Paris Agreement stocktake around the corner, this work provided a logic for countries across the continent to emulate in revising their NDC commitments. This is the logic of combining complementary sectors to maximise the cumulative socioeconomic and climate benefits. For example, Mozambique proved that combining energy and agriculture could sequester 70% more carbon and earn twice as much in enterprise profitability. This is a clear lesson for countries to prioritise both conditional and unconditional NDC commitments in complementary catalytic sectors that can be combined to maximise throughput.

- Second, while policy is the biggest driver of change, integrating low emissions development lessons into policy for uptake in investment is not a linear process. By putting together policy taskforces, this work demonstrated that environment ministries need to work with key productive ministries (energy, agriculture, forestry, transport and others prioritised in the NDCs) to ensure development policy prioritises investment in the low emissions pathway. This is a lesson on how low emissions development priorities can be taken up for investment by mainstream development policy.

- Third, among the leading socioeconomic priorities for Africa, is the need to create no less than 12 million jobs each year. This work provided modelling tools, that countries could emulate, to ensure they accurately establish areas of NDC investment with key socioeconomic benefit in jobs and enterprise opportunities. Cameroon proved through their model, that their country can create 5 million more jobs relative to BAU, if they prioritise the low emissions pathway. They proved that a country could invest in sectors popular amongst the youth – like ICT – and link them to enable productivity maximisation in economically inclusive sectors like agriculture and energy to unlock more youth-friendly jobs while lowering emissions.

- Fourth, this work has established a timely foundation for ramping up south-south cooperation in the area of NDC implementation towards achieving low emissions development. The intra-continental lessons sharing facilitated by the communities of practice structure and through AMCEN serve to further solidify south-south cooperation for low emissions development in the continent.