



Coupling access to sustainable energy with mitigation of deforestation in the ACP region

Experiences from EU-supported projects in ACP countries 2007-2019



7 AFFORDABLE AND CLEAN ENERGY



15 LIFE ON LAND



The ACP-EU Energy Facility (<http://energyfacilitymonitoring.eu>)

This discussion paper is one in a series of discussion papers based on experiences from the ACP-EU Energy Facility (EF).

The EF was established in 2005 to co-finance projects on increasing access to modern and sustainable energy services for the poor in African, Caribbean and Pacific (ACP) countries, especially in rural and peri-urban areas. 173 project proposals have been granted co-funding from the EU for a total of 0.4 billion euros; 50% of the total project-budgets of 0.8 billion euros.

The projects have been, and are being, implemented in the period 2007–2021 with 90% of projects completed in 2019. The projects cover a wide range of technologies:

Electricity grid-extensions in rural and peri-urban areas, hydro-powered mini-grids, solar and hybrid-solar mini-grids, stand-alone solar solutions for businesses, households and public institutions, portable solar equipment mainly used for lighting, clean energy solutions for cooking such as improved firewood and charcoal cook stoves as well as biogas, biofuels for electricity generation, and capacity development of public institutions in the energy sector.

Among the 173 Energy Facility projects, 34 are directly related to SDG15: Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.

Danish Energy Management (DEM) has been granted the contract of providing technical assistance for the monitoring of the EF projects in the period 2011–2019. This discussion paper is based on information and data gathered during this period as well as current research and experience from other development interventions.

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Introduction

This discussion paper examines how improved access to sustainable energy solutions can contribute to mitigate deforestation in developing countries.

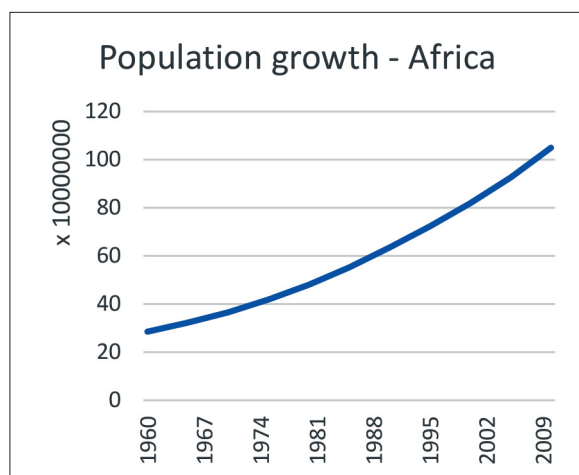
The background chapter identifies the key trends in sub-Sahara Africa and places the actions in the energy sector in a larger context. In the subsequent chapters, experiences from the ACP EU Energy Facility are analysed covering four ways of improving access to energy that are especially relevant to protect forest resources:

- a) improved cookstoves
- b) improved charcoal production
- c) afforestation
- d) fuel switch to biogas

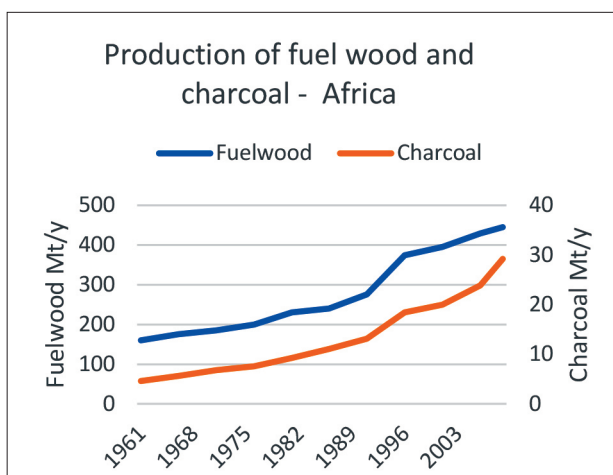
Background

Demand for cooking fuels is a significant driver behind deforestation in sub-Saharan Africa. It is estimated that 78%¹ of the population use firewood and charcoal to meet their cooking and heating needs and there is a direct correlation between population increase on the sub-continent and the decline of the forest cover. Moreover, migration of people and influx of refugees exacerbates fuelwood demand which increases the level of deforestation².

Increasing demand for fuelwood is also associated with income levels. High income households demand proportionally higher quantity of fuel – generally wood or charcoal. As the graphs below show, there is a clear correlation between population growth and growth in the production of fuel wood and charcoal.



Source: World data. World bank



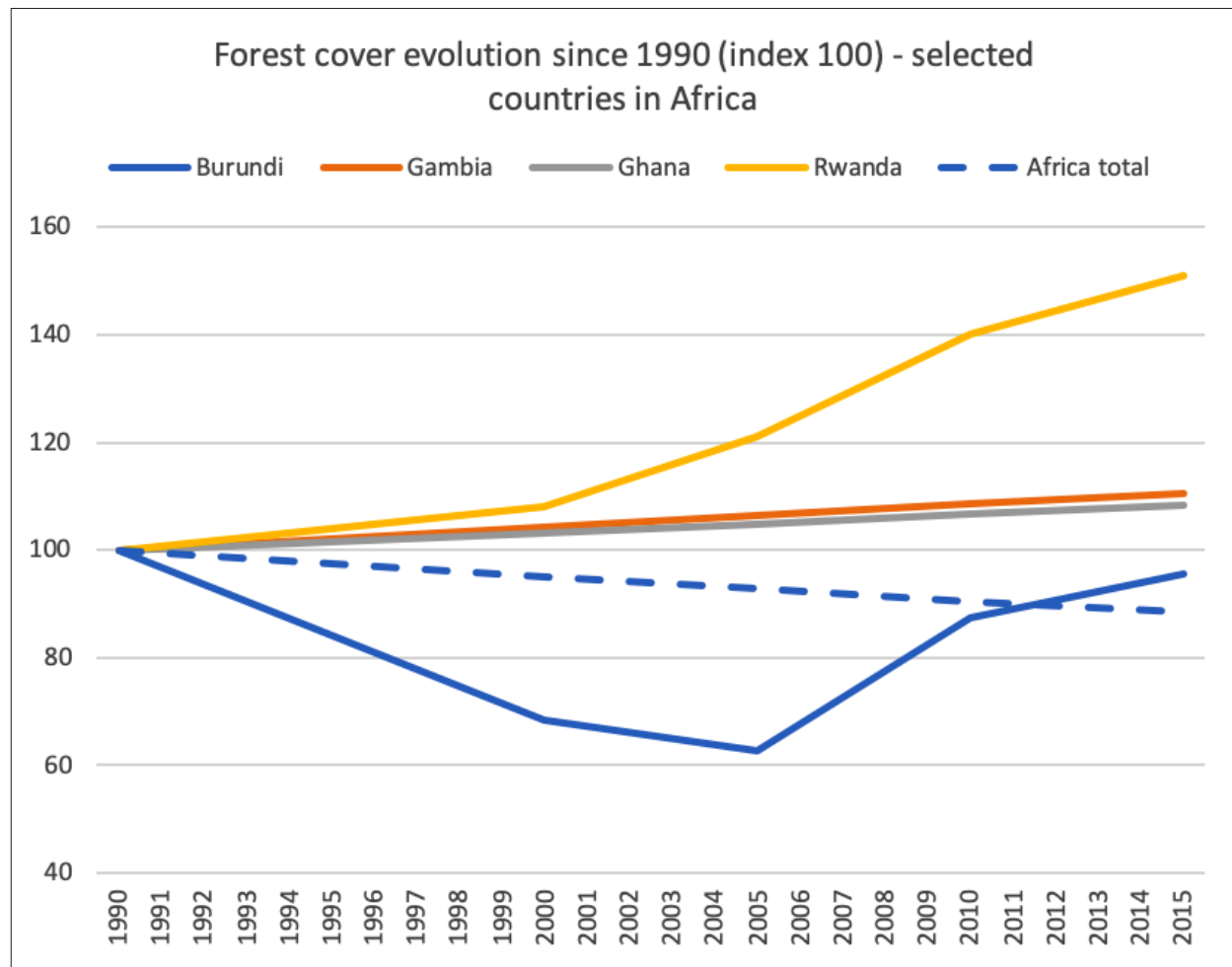
Source: Subedi, et al., 2014³

¹ McKinsey 2017. <https://mckinseyenergyinsights.com/insights>

² One example is Bibi Bidi in Uganda which is the second largest refugee settlement in the world. Bibi Bidi was opened in 2016 to accommodate refugees fleeing the South Sudanese civil war. In 2017, an annual wood consumption of 300,000 tons was estimated which would completely deplete the forest within three years if no cautionary measures were instituted. FAO and UNHCR recommended growing of early maturing trees to supplement wood fuel, construction materials and animal fodder. The EF project Access to energy services in rural and peri-urban areas in Northern Uganda (Teko Wa Project) is promoting improved cooking stoves and tree nurseries in this area.

³ Subedi, et al., 2014. Can Biogas digesters help to reduce deforestation in Africa? Madhu Subedi, Robin B. Matthews, Mark Pogson, Assefa Abegaz, Bedru Babulo Balana, Joseph Oyesiku-Blakemore, Jo Smith. In Biomass and Bioenergy 70 (2014) 87 – 98.

It is only logical that the evolution in tree cover is directly opposite. However, the correlation is not as causal as it appears and a few countries in sub-Saharan Africa, like Burundi, Gambia, Ghana and Rwanda, have successfully been able to reverse the trend and have had increasing forest cover the last couple of years despite population growth.



Source: Keenan, et al., 2015⁴

One key factor for this reversal is existence of an enabling environment. This can be political, cultural and economic-driven. A conducive policy framework addresses unsustainable exploitation of forest resources for fuelwood. The policies can be national or regional and address different sector⁵. Concerning energy, for instance, Kenya's Improved Biomass Cookstoves Regulations 2015 and the ECOWAS Renewable Energy Policy (EREP). The Regulations guide the activities of improved biomass cookstoves producers, manufacturers, importers, distributors, technicians and contractors of cookstoves in Kenya while the EREP aims for its member states to adopt high-efficient firewood and charcoal cookstoves with an efficiency of at least 35% (ECREEE, 2017). Development and enforcement of quality regulations and standards in the cookstove sector goes a long way in addressing deforestation.

Rwanda, one of the countries that has been mentioned to have successfully reversed deforestation, stepped up its efforts to regulate use of biomass and promoting energy efficient cooking solutions. It also provided a subsidy to the National Cookstove

⁴ Keenan, et al., 2015. Dynamics of global forest area: Results from the FAO Global Forest Resources Assessment 2015. Rodney J. Keenan, Gregory A. Reams, Frédéric Achard, Joberto V. de Freitas, Alan Grainger, Erik Lindquist. In: Forest Ecology and Management 352 (2015) 9–20.

⁵ See also annex 2 for an example of a regional deforestation program in Central Africa.

Programme. The country has so far disseminated 30,000 cookstoves with a target of 2 million by 2020. Other countries that have restrictions on charcoal production include Malawi, Chad and Kenya. Regionally, the Eastern Africa region provides the best enabling environment for cookstove projects and programmes compared to, especially, West Africa.

How improved access to sustainable energy can mitigate deforestation

Industrial demand for biomass (wood logging for instance) is one of the main drivers of deforestation. This is especially in cases where the firms have not established their own woodlots and thus depend on private supply of firewood. Unscrupulous private suppliers most of the time invade public forests from where they get their firewood.

Even though the demand for wood-based fuels for cooking is not the only cause of deforestation, it is a significant driver behind deforestation as well, and it is primarily in the area of reducing the demand for wood-based fuels, that the ACP EU Energy Facility has contributed by improving the efficiency of cooking technologies; optimising the heat transfer from every kilogramme of fuel through use of improved cookstoves.

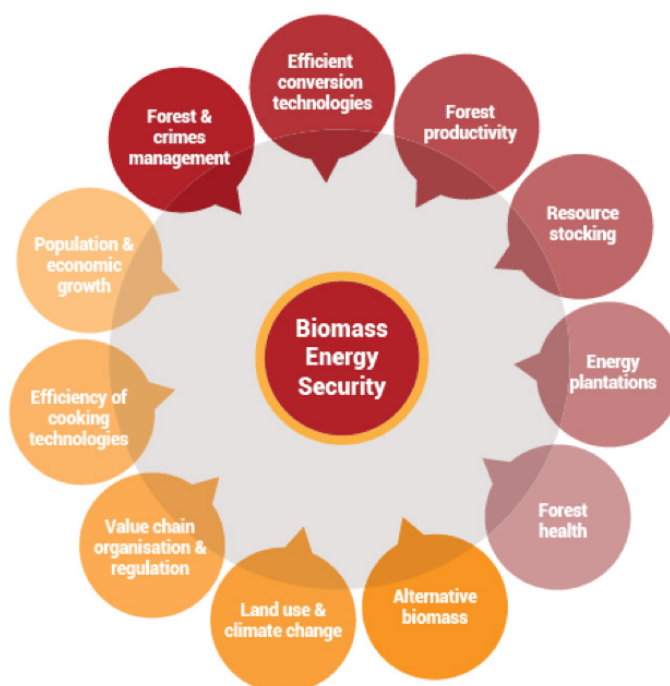


Figure 1: Biomass Energy Security Framework⁶

Fuelwood stoves versus charcoal stoves

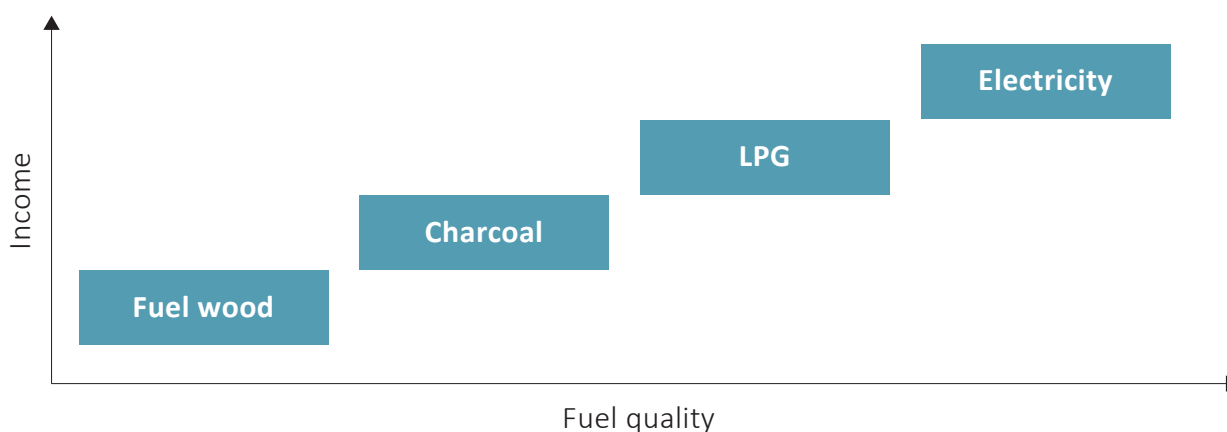
In an efficient cookstove using dry fuelwood with a small or double combustion chamber and controlled air inlet would be the optimal solution for getting the most cooking heat out of that energy resource⁷. However, the calorific value of charcoal per kilogram will always be better than fuelwood, making it much easier to transport and distribute and easier to handle. Charcoal is also able to produce higher intensities of heat and will produce less smoke making it easier to handle for a variety of cooking

⁶ EAC Energy Security Policy Framework 2018. United nations Economic Commission for Africa

⁷ Energypedia (undated). Cooking with woodfuels (firewood and charcoal). [https://energypedia.info/wiki/Cooking_with_woodfuels_\(Firewood_and_Charcoal\)](https://energypedia.info/wiki/Cooking_with_woodfuels_(Firewood_and_Charcoal))

practices. The down-side to charcoal, in relation to deforestation, is that a substantial amount of energy is lost in the conversion increasing the cost of production and the negative impact on forest cover. This is in addition to the increased cost per joule of energy.

The Energy Ladder has for a long time been a standard assumption among professionals to illustrate the changing preferences of cooking fuel that follows increased income. The Energy Ladder describes a general tendency for households worldwide to choose a cooking technology based on a superior fuel in terms of energy density, heat intensity, ease of use etc. as their income increases.



The Energy Ladder for cooking wrongly depicts a natural linear progression that does not consider access to fuels and stove models as well as other factors such as cooking practices. It does, however, rightly depict the over-all tendency for higher income households to prefer charcoal over firewood and LPG or electricity resulting in a strong demand for charcoal in urban areas in sub-Saharan Africa where income is generally higher than in rural areas and where firewood is not locally available⁸. So, even though fuelwood used in high quality stoves are to be preferred over charcoal, demand for charcoal will remain important for a long time and, therefore, adaptation of efficient techniques for charcoal production are essential.

Therefore, a second approach is to reduce the energy required to convert wood into charcoal through adoption of new and more efficient improved charcoal production techniques. Important to note that despite the efficient way of charcoal production that produces better quality charcoal, the conversion process can generate up to six-times⁹ of greenhouse gases emissions compared to using fuel wood.

Thirdly, some energy projects have engaged in afforestation activities through establishment of nurseries and woodlots with an aim of mitigating deforestation as well as meeting the growing demand for fuelwood.



Photo: Danish Energy Management (DEM)

⁸ From Linear Fuel Switching to Multiple Cooking Strategies: A Critique and Alternative to the Energy Ladder Model. World Development 28(12):2083-2103 · December 2000.

⁹ This includes CH₄-emissions

While improved cookstoves, improved charcoal making and tree planting all contribute significantly to mitigate deforestation, the core problem lies in the dependency on wood-based fuels. This is further complicated by the current status where firewood is mostly freely collected. Introducing processed fuelwood (charcoal, pellets, briquettes, etc.), which comes with an added cost will further alienate uptake. While liquefied petroleum gas (LPG) stoves have been the prime candidate for a fuel switch away from biomass, LPG is a fossil fuel which can be seen as in contradiction with global efforts to mitigate climate change. Biogas digesters, on the other hand, tackles that conundrum by offering a fossil fuel free substitute to LPG stoves with promising results.

Impacts on forests

Limited options for income generating activities among communities with forest lands and in low rainfall areas, has made charcoal production an important activity causing deforestation to the already exploited tree cover. Fuelwood extraction and deforestation can lead to resource depletion on a local scale and have led to shortages in areas where rates of extraction out-strip supply. It also contributes to forest degradation and has negative impact on forest health and biodiversity, due to chronic removal of small trees or branches over a prolonged period, including removal of habitat as well as disruption of nutrient recycling processes.

The Energy Facility projects have not funded large scale scientific studies that could document the impact on forest cover of the good results many of them have accomplished; the focus of the projects is that of action, in many cases in a limited geographical area, and within a limited time period that does not allow for that kind of documentation.



Energy efficient stove, rocket model
Photo: Danish Energy Management (DEM)

However, use of efficient cookstoves contribute to reduction in deforestation as the quantity of fuelwood used for cooking is greatly reduced owing to higher cooking efficiencies. Strategies to further improve cookstoves efficiencies should be promoted to further address deforestation concerns. A 50%¹⁰ fuelwood savings was reported in one of the Energy Facility projects (*Improved Cookstove for Households and Institutions in Kenya*). This fact (fuelwood saving) alone made selling of the technology far much easier long after the project had ended.

The *Community-assisted Access to Sustainable Energy Project in Rwanda* that aimed at reducing the gap between biomass demand and supply through dissemination of improved cookstoves and improved charcoal production technologies managed to disseminate improved stoves to over 27,000 households, impacting on the wellbeing of approximately 135,000 persons, as well as training 129 charcoal producers to reduce wood use by up to 50%. This reduced fuelwood demand by more than 60%. This project will be highlighted in more detail in the Section 4.

With improved cookstoves disseminated in Mali with a lifespan of 2 years through the project '*Access to Modern and Sustainable Energy Services*', these cookstoves saved about 11 tonnes of fuelwood including 6 tonnes of non-renewable fuelwood.

Moreover, the case for biogas is relatively clear - the quality of the energy source and ease of handling it (as explained above) means that close to 100% substitution can be expected when promoting biogas for cooking instead of fuelwood or charcoal. It is estimated that biogas can potentially decrease deforestation caused by fuelwood demand by 10-40%¹¹.

Efficient Cooking Technologies: Improved Cookstove Efficiencies

International Workshop Agreement (IWA)¹² provided a guideline for policymakers, investors, manufacturers and others in the cookstove sector and informs future work required in developing new or revised internationally agreed upon cookstove standards and protocols. The rating system defines tiers of performance in the areas of fuel efficiency, emissions of fine particulate matter (PM 2.5) and carbon monoxide (CO), indoor emissions (particulate matter 2.5 and carbon monoxide), and safety. This guideline emphasises the need to go for higher ranked cookstoves as they induce the smallest negative health impact on the users as well as on the environment in terms of pressure on forest resources.

Numerous cookstoves have been developed with different efficiencies. Envirofit stoves are reported to have 80% emission reductions, 60% fuel saving, 40% reduction on cooking time and has a lifespan of about 5 years. Ugastoves which are arguably the commonest in Uganda, have 36% fuel saving (charcoal stoves), 58% fuel saving for the rocket type with an estimated lifespan of 3 to 5 years. In the case of Centrafricain which is popular in Central Africa, it has a fuelwood expenditure reduction of 25%¹³.

The higher the cookstove efficiency, the higher its costs that mostly range from US\$25 to 35. These cookstoves are predominantly charcoal stoves used in urban areas where the disposable incomes are higher. Examples of such cookstoves include jiko okoa (Burn stoves) and Envirofit which are manufactured both locally and internationally. Cookstoves that are accessible to rural and urban poor household range from US\$2.5 to 5.5. These include the Kenya ceramic jiko, rocket stoves, upesi, okelo kuc, etc.

¹⁰ This was not independently verified.

¹¹ Can Biogas digesters help to reduce deforestation in Africa? Madhu Subedi, Robin B. Matthews, Mark Pogson, Assefa Abegaz, Bedru Babulo Balana, Joseph Oyesiku-Blakemore, Jo Smith. In Biomass and Bioenergy 70 (2014) 87 – 98.

¹² <https://www.cleancookingalliance.org/technology-and-fuels/standards/iwa-tiers-of-performance.html>

¹³ Urmee T. and S. Gyam, 2014. A review of improved Cookstove technologies and programs. <https://www.sciencedirect.com/science/article/pii/S1364032114001300>

Local government level	
✓ Positive health impacts (e.g. less indoor air pollution) ✓ Gender related – decreases opportunity cost of collecting firewood and, thus, the quality of life and economic opportunities of women ✓ A variety of proven technologies that can be produced using locally available materials ✓ Builds on well-established value chains: Uses existing fuels	÷ Uptake can be slow – might entail a change in cooking practices and low decision-making power in the household is a barrier ÷ In some cases, difficult to arrive at economies of scale for stove producers and retailers ÷ Tendencies for households to use traditional stoves due to cultural inclinations despite owning an improved cookstove



Figure 3: Kuni mbili stove that uses both firewood and charcoal ideal for either rural or urban areas.



Figure 4: Kenya Ceramic Jiko – one of the most widely disseminated cookstoves in sub-Saharan Africa.

Discussion Paper 7 focusses specially on best practices for actions promoting improved cookstoves which has been the most important technology promoted in the ACP EU Energy Facility to mitigate deforestation.

While improved cookstoves remain the most important contribution, other types of technologies and approaches have also been implemented in the ACP EU Energy Facility.

Improved Conversion: Efficient Charcoal Production

Demand for charcoal in urban areas has a strong impact on both private and public forests hundreds of kilometres away and the charcoal business of cutting timber, producing charcoal and distributing it to urban centres is an important sector in the countries' economies often regulated by governments with varying degrees of success.

Despite the importance of the charcoal industry, the techniques used to convert the wood fuel into charcoal are often primitive, no different than the approach used in rural villages, and there is a considerable gain to achieve both in cost of improving the income for the charcoal producers, increasing the calorific value of the charcoal, as well as decreasing the negative impact on forest cover, and reduction of greenhouse gases, by adopting effective and efficient methods.

To effectively maximise on the quality of charcoal production using improved techniques the wood should firstly be well dried for at least one month before carbonisation. Secondly, the wood diameter should be homogenised. Largest wood logs must be split first or put in the middle of the woodpile. Thirdly, mixing of various wood species should be avoided as each wood species has its own pyrolysis time. Finally, air exclusion, temperature and humidity must be controlled to optimise charcoal production.



Figure 4: Kenya Ceramic Jiko – one of the most widely disseminated cookstoves in sub-Saharan Africa.

The different kilns used for production can be categorised into four main types:

Traditional kilns – these constitute earth pit and earth mound kilns. Earth pit kilns are the traditional way of producing charcoal. Pieces of wood are stacked in a pit and later sealed with a layer of grass and soil. Process of carbonisation is begun by igniting the wood at one end. In an earth mound kiln, wood is collected and stacked in the polygonal shape of kiln. The wood is then covered with a layer of grass and later sealed with soil. A small opening allows the control and monitoring of the process.

The drawback with traditional kilns is that quality of charcoal produced is of low quality with efficiency levels of 8-12%. Thus, charcoal production using traditional kilns is associated with high consumption of wood. Comparing the two traditional kilns, earth mound kilns are more efficient than earth pit kilns.

Improved traditional techniques – the Casamançaise kiln, which was originally developed in Senegal, is an earth mound kiln with a provision of a chimney. The chimney allows for better control of air flow. Moreover, the hot flues do not escape completely but are partly redirected into the kiln, which enhances pyrolysis. This makes charcoal production faster than the traditional kilns and it is also of better quality. Its efficiency is much higher too, 12-17%.

Industrial production technologies – these constitute brick, steel and Adam retort kilns. Brick kilns have efficiency of up to 30% and are suitable for semi-industrial production of charcoal. The kiln is made entirely out of brick and mud as mortar. Loading and unloading is performed through two opposite doors, which are sealed before the kiln is ignited. The carbonisation cycle is much quicker and allows harvesting of charcoal after 13-14 days.

New high yield low emission systems – Different types of steel kilns have been developed which are considered as one basis of modern charcoal production. They are capable of carbonising poor-quality wood and can easily be transported when necessary. Steel kilns are not suitable for high volume production and the cost of installation is prohibitive to low income countries. It has an efficiency of 27-35%.

The Adam retort kiln presents a very efficient way of producing good quality charcoal. The kiln returns the wood gases from the carbonisation chamber to the external firebox. Adam retort kiln has an efficiency of up to 35% and the ability to reduce 70% of poisonous gases.

Table 1: Efficiencies of various types of kilns¹⁴

Type of kiln	Production of 1kg of charcoal from	Kiln efficiency
Traditional	8-12 kg wood	8-12%
Improved traditional	6-8 kg wood	12-17%
Industrial production technologies	5-7 kg wood	14-20%
New high yield low emission systems	3-4 kg wood	25-33%

Pros and Cons of Improved Firewood Conversion	
✓ High income effect for local charcoal producers ✓ Effectively reduces pressure on forest (forest regulation a condition)	÷ Even though conversion of wood into charcoal is optimised, energy is still lost in the conversion and charcoal will still be a more destructive fuel source ÷ Producers might not have the bargaining power to increase the price per kilogram even though the quality has improved

While introducing improved kilns, it is important to determine whether the market is willing and able to procure all charcoal brought for sale. One ACP EU Energy Facility project implemented in Tanzania and Mozambique (*Sustainable Wood and Charcoal Production in Rural Mozambique and Tanzania*) helped farmers establish woodlots and later convert it into charcoal. However, it did not take off as expected as the project beneficiaries preferred to continue using fuelwood as their primary energy source, rather than converting the wood to charcoal before using it. Additionally, the commercial market for charcoal did not materialise because of very low prices making it economically unviable. One Energy Facility project that succinctly addresses fuel switch from fuelwood to charcoal is the *Community Assisted Access to Sustainable Energy Project* in Rwanda.

Case Study: Community Assisted Access to Sustainable Energy Project in Rwanda

More than 96% of Rwandans still depend on fuelwood for their domestic needs. Although there exist alternative sources of energy, they are beyond the reach of urban poor as well as rural households. Furthermore, these alternative fuels are considered unreliable by majority of Rwandans. The demand for land and the degradation of natural resources will only increase with the growing population, making it important to find a sustainable solution to the energy needs of the country. The project addressed these major needs and constraints through the dissemination of alternative sources of energy. Project activities were rooted within the local communities and supported by the national energy strategies which are aimed at saving biomass through increased energy efficiency, reforestation and introducing alternative energy sources.

The project targeted 120,000 beneficiaries in the districts of Nyamagabe, Nyaruguru, Gisagara and Huye. This included 100 charcoal producers.

Among other activities, the project organized and trained 129 charcoal producers on the use of Casamançaise kiln, rectangular kiln on the hillside and rectangular kiln on terrace. Adoption of improved kilns allowed charcoal producers to reduce the quantity

¹⁴ https://energypedia.info/wiki/Charcoal_Production

of wood carbonised by up to 50% compared to the traditional kilns. The quality of charcoal produced was also much superior compared to using traditional means. While the number of bags produced from one ton of wood through traditional kilns could only yield about 3 bags, with the improved kilns the number of bags produced doubled. As observed in the Discussion Paper 7 on cookstoves, a strong income generating component guarantees sustainability of projects long after the end of the project.

Additionally, the ownership by community members of these techniques, and the fact that they are easy to transfer means that the charcoal producers have continued the practices long time after the project ended and it is now the dominant method applied in the region. With an increasing demand for charcoal in urban areas and increasing scarcity of fuelwood in rural areas, the willingness of government and other stakeholders to continue support to the new methods has guaranteed the sustainability of the project benefits. Local government officials are for instance systematically connecting woodlot owners that might live in urban areas far away, with the local producers trained in the methods, when they apply for permit to produce charcoal on their wood lots. Through the assistance of local government, the approach has also been replicated in other projects in the region.

Afforestation: Seedling Production

Afforestation can take many forms – from large scale industrial energy plantations run by government programmes or private companies, to small scale initiatives to produce seedling in the local area in order to promote forest regrowth. To make afforestation projects more appealing to end-users, there must be an income generation component. Establishing a woodlot and having to wait several years for one to start benefiting from it can be a great drawback especially for small scale farmers. Adoption of fruit tree species that start fruiting in their second or third year are more beneficial than establishing woodlots that take more than five years for farmers to start economically benefitting from them. Moreover, these fruit tree plantations can be felled for fuelwood when production start declining.

Through reliable data, most institutions and industries across sub-Saharan Africa have come to appreciate the gravity of their intensive consumption of biomass fuels. These fuels (charcoal and firewood) are used to either prepare meals or process tea, sugar, tobacco etc. To avert further overexploitation of forest resources, these firms have contracted large scale farmers around their locality to supply them with timber. On their part, the firms provide seedlings with guaranteed purchase of the delivered fuelwood upon maturity.



LWF staff grow, multiply and distribute tree seedlings to refugees and host community residents in Northern Uganda
Photo: DEM

At a local scale, to meet their own fuelwood energy needs, most farmers are engaging in agro-forestry¹⁵ where trees are intercropped with other crops. A section of the farm is dedicated towards establishment of a woodlot and in cases where the farms

¹⁵ By Kenyan law, each farmer is required to ensure that at least 10% of his/her farm is under forestry. The challenge has been enforcement so far has been in enforcement of the law. Rwanda has also been progressive on matters afforestation.

are too small to adopt this, trees are planted along the farm border which start providing fuelwood from the point of pruning until they are mature for harvesting.

Ideally, forests regenerate themselves but owing to excessive human interference through cutting down of trees. If more effort was put into establishment of more tree nurseries to supplement low regeneration of natural forests and more concerted effort in checking level of tree felling, the rate of deforestation would not be as high. One key advantage of establishing small local value chain around tree nurseries is the opportunity it presents – harvesting forest products which can lay the basis of increased awareness on forest protection.

Owing to prolonged life cycle of forestry projects, it makes it very complicated to measure its success with parameters provided by the Energy Facility. Despite this, we can still draw some lessons learned from some of the ACP EU Energy Facility projects.

The *Improved cookstove for households and institutions project* in Kenya increased nursery owners' revenues through training on outreach to farmers and other potential clients. Tree nursery owners in one of the project sites reported increased incomes owing to higher sales. These forestry entrepreneurs could now make visits to farmers and provide advice on the best species for woodlot establishment. Woodlots were established in public schools as well as tertiary institutions. On maturity, the woodlots will save the much-needed resources to expand their services.

On the other hand, another project *Promoting use of sustainable energy in Wajir District*¹⁶ in Kenya, had limited success. There was an attempt on afforestation in public spaces (schools and government offices) but owing to improper planning and neglect, most of the planted trees were either destroyed by the prolonged droughts or fed on by animals. There were limited pockets of afforestation in schools that managed to care for the tree seedlings. The trees now provide protection through sun-shading making classes in mid-morning and afternoon more tolerable.

Pros and Cons of Seedling Production	
✓ Creates a market for afforestation to supplement existing fuelwood markets, that are linked to deforestation	÷ Requires continuous care over time to become a stable business
✓ Provide income for local communities	÷ Local demand for seedlings might be low and larger scale markets in urban areas impossible to reach
✓ Could have strong local support from communities as well as local authorities	÷ Cannot replace the quick income gained by cutting forest to sell fuel wood

Case Study: Deployment of new development opportunities socio-economic through access to sustainable energy in the Central Plateau

This project was conceived from wanton human activities in originally forested land which resulted in a devastating effect on the environment. There were predictions of an energy crisis as well as food security concerns if the trend was not reversed. Additionally, there was very low awareness on the gravity of the problems caused by human factors.

To address the challenges, the project aimed at training households on agroforestry, nursery establishment, distribution of seedlings to families and actualising community afforestation in response to continued deforestation and unsustainable agricultural practices practised in the Central Plateau.

¹⁶ This is a semi-arid county in Eastern Kenya that experiences drought for prolonged period in multiple years.

From the project, there was a total of 16,255 surviving trees on 11.30 hectares of community plantations. There was also an additional 1.16 hectares for afforestation with the capability of accommodating another 2,000 seedlings. Owing to proper care provided by the project, the survival rate of the tree seedlings was 93%. The project directly benefitted a total of 96 households (423 individuals) people who were each issued with 200 tree seedlings for planting on their farms. Another 96,873 tree seedlings were issued to private farmers living around where the nurseries were located. Consequently, a total of 113,128 trees were established by the end of project.

On private agroforestry farms with a planting density of 8m² per plant, against the 6.25m² per plant in the dedicated community orchards which corresponds to 57.88 hectares under forest. On household farms, portion of the land occupied by the new agroforestry was around 13%.

From the established forest, households could conveniently access firewood. Nutrition of the households also improved from consumption of fruits with excess sold in the market for additional income.

Fuel Switch to Alternative Solid Fuels

Higher cost of fuelwood deters demand and vice versa, prompting the need to institute a fuel switch. In places where there is no option of planting trees for own fuelwood supply, the population tend to rely on already depleted forest resources. To avert further crisis, there must be concerted effort in promotion and provision of alternatives to fuelwood such as use of electricity, LPG and others. To advance the uptake of alternatives, national governments in developing countries should make deliberate actions such as provision of incentives to encourage switch from fuelwood to alternatives. A handful of Energy Facility projects have experimented with alternative solid fuels.

Considering the high cost of firewood and the inconsistent supply of LPG and Kerosene, the only other alternative fuel for end-users in rural areas was livestock dung. The project *Provision of Efficient, Affordable and Sustainable Energy for Cooking and Heat to Rural Households in Eritrea* promoted dried cow dung and adapted stoves as an alternative to the scarce supply of fuel wood as well as improved stoves for fuel wood. Through a survey conducted by the project, it was confirmed 59% and 67% of improvement or reduction in dung and fuelwood consumptions respectively. Additionally, there was a 50% reduction on time spent fetching firewood.



Eco-stove
Photo: DEM

In another Energy Facility project, *Promotion of Typha Charcoal as an Alternative to Charcoal* in Mauritania, potential use of typhi as an alternative to firewood for charcoal production was established where typhi was dried, cut, mixed with straws or rice husks, and converted to either charcoal pieces or briquettes. Buoyed by government policy, this project can be scaled up with the eventual result of decreased

deforestation in Mauritania. The experience in Mauritania spread downstream into Senegal where typhi was threatening local ecosystems.

Despite the potential of solid fuel alternatives to fuelwood and charcoal can reduce forest pressure, fuel switch to these sources of cooking energy have in general been curtailed by low purchasing power especially amongst the rural households and the urban poor. Cost of producing alternative solid fuels is higher than producing fuelwood or charcoal, and – to a large extent – most of the available fuels such as pellets and briquettes are imported in most of the poor countries instead of being produced locally. The high production cost is brought about by high cost of electricity and raw materials. Moreover, due to their bulky nature, they attract high transport cost and the poor road network implies they cannot reach where they are needed the most. There is also low awareness level on availability and how to use these alternative solid fuels.

To address the above-mentioned limitations, national governments should provide tax subsidies on solid fuels to make them more affordable to the vulnerable households. Awareness on their effectiveness and availability can be met through advocacy. Solid fuel manufacturers should also enter into contractual agreement with farmers which will guarantee supply of raw materials within the locality. This significantly reduces the cost of production. Briquette manufacturers can piggyback on the agricultural sector where they can make use of crop residues that would otherwise go into waste.

Pros and Cons of Fuel Switch to Alternative Solid Fuels

✓ Reduces the pressure on one of the solid fuels	÷ If any of the fuels is unsustainably sourced, can lead to deforestation
✓ Opportunity for another revenue stream from the new fuel	÷ Unaffordability for poor households (production cost, packaging, distribution, etc.)

Fuel Switch to Biogas

Biogas presents an excellent opportunity for fuel switch from fuelwood. There are numerous advantages of biogas. Key among them is that it provides an improved indoor air quality. Being a clean-burning cooking fuel, it reduces the risk of indoor air pollution and associated lung diseases when compared to fuelwood and charcoal. Biogas reduces dependency on limited fuelwood and charcoal resources thus aiding in forest conservation. It also contributes to food security through use of slurry which is a good organic soil conditioner. Biogas systems offer a safe and affordable solution for waste management, helping schools and communities manage human and animal waste safely. Another advantage with biogas is that it guarantees energy security. Households and communities can get empowered to be self-sufficient with a sustainable cooking fuel.



School kitchen using biogas
Photo: DEM

In addition to helping rural communities meet their energy needs sustainably, both rural and urban areas stand to benefit from installation of institutional biogas. These include boarding schools, prisons etc. By the beginning of the new millennium, Rwanda's prison population had increased to about 120,000. Sewage disposal became a major health hazard for the prisons and the surrounding areas, with the waste produced outstripping the institutions' waste handling capabilities. The demand for firewood, which was the main source of fuel for cooking and heating in prisons, also increased in direct proportion to the number of prisoners. These challenges were all addressed by installation of biogas in the prison. Institutional bio-digesters have also been successfully installed in other countries. For instance, Central University College in Ghana with a student population of 7,650 provided adequate feedstock for the biogas plant.

There is a compelling case for biogas. Schools, hospitals, prisons, businesses in informal settlements and some tourist lodges depend on firewood, charcoal and LPG for cooking. Increasing costs of fuels are major issues that institutions would like to do away with. Once energy demand has been established and availability of feedstock, fuel costs can easily be managed through installation of biogas. Biogas systems has very different lifetime depending on the model used. Firewood and charcoal prices continue to increase, making biogas a more affordable alternative.

Pros and Cons of Biogas Switch	
✓ Reduces dependency on fuelwood or charcoal ✓ Slurry from bio-digester is an excellent soil conditioner that boosts productivity ✓ Innovation in membrane-models have made these much more effective	÷ Despite the strides made in innovation of bio-digester membranes, they are still unaffordable to vast majority in the rural areas without access to credit facilities ÷ The technology works best in a zero-grazing set-up which is an expensive venture for the rural poor ÷ Markets in the ACP-region are not yet developed to a level where spare parts (mainly the burner) are locally available ÷ Membrane-models are easier to install, but less durable on the longer term than fixed dome models ÷ Requires some space, which is a challenge in densely populated villages and peri-urban areas

Case study: Programme for the Establishment and Dissemination of Bio-digesters in Rural Areas of Senegal (PIDB)

Senegal was successful in encouraging fuel switch from fuelwood to LPG. Through LPG subsidies as well as innovative packaging of the gas, many households switched to it thus alleviating the pressure on forests. This resulted to 90% adoption in Dakar and 60% in secondary cities¹⁷. These gains made were unfortunately undone when the subsidy was removed.

The PIDB project aimed at providing rural and peri-urban households in nine regions in Senegal with sustainable source of energy, both for cooking and lighting, as well as organic fertiliser to support their agricultural activities.

The project uses a market-based approach to disseminate the bio-digesters. Many actors were trained on the biogas value chain which saw emergence of new traders such as craftsmen and biogas masons whose vocation is to build bio-digesters or manufacture related accessories and spare parts.

¹⁷ Karekezi, S. et al 2007. Successful Energy Policy Interventions in Africa. Eschborn, Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH

One major difference between the biogas digestors and stoves promoted now compared to the prior LPG program is the that fertilizer can be produced from the bio-digestors and, thus, generate an important income for the farmers. Initially, the project provided a subsidy on the bio-digestors which made them accessible to poor households in rural and peri-urban areas, but the subsidy has ended. Farmers can now repay the cost of the bio-digestors through sale of sludge; a new revenue stream from use of biogas.

The project is still ongoing, but there are promising signs that the program has found a sustainable path to supporting fuel switch from fuelwood to biogas. In addition, the project has created more local jobs compared to the LPG national programme.



*Eco-stove
Photo: DEM*

Conclusions and Lessons Learned

The most important energy measure to mitigate deforestation is promotion of improved cookstoves. Given the relatively low levels of dissemination of improved cookstoves in developing countries, and the projected increase in the number of people relying on biomass, the potential for clean biomass cookstoves is significant. The use of improved cookstoves have numerous benefits: 80% emission reductions, 60% fuel saving, 40% reduction on cooking time and with a lifespan of more than 2.5 years up to 5 years for the imported cookstoves such as Envirofit.

Other measures include the use of modern charcoal conversion technologies which yield twice as much when compared with traditional methods. The resultant effect of this is a general reduction in woodfuel use thus saving on deforestation. Innovative financing is required to make modern kilns accessible to small and medium scale businesses engaged in the inefficient production method in the rural areas.

There has been much concentration on afforestation with the intention of producing woodlots. However, woodlots take many years to mature before they can be harvested: Establishing a woodlot takes approximately seven years to mature. If fruit trees would be chosen or mixed with the woodlot tree species, farmers can start deriving incomes through sale of fruits and thereby afford other fuel alternatives. Tree planting is a good thing as there are other benefits of such forests including carbon sinks, ground cover protecting the soil from erosion, deterrence of spread of desertification and offer a good buffer zone for re-establishment of other flora and fauna. The lesson learned here is that afforestation is closer linked to income generation in general than to production of fuel wood. This approach guarantees sustainability of the project impacts.

To encourage fuel switch from fuelwood and/or charcoal to other solid fuels; governments should work with private actors to bring down the cost of production. This can be achieved through provision of subsidies as well as providing a favourable enabling environment where end-users can improve their economic wellbeing so that they can be able to afford alternative fuels when the subsidy comes to an end. Other than biogas, there are alternative fuels that rural and urban poor households can adopt. These include cow dung, invasive weeds, briquettes, wood pellets, etc.

Recommendations

- New strategies to be adopted to improve uptake of improved cookstoves.
- Innovative financing targeting the traditional charcoal producers in the rural areas to adopt modern charcoal conversion technologies.
- Growing of fruits trees instead of pure woodlot tree species – sale of fruits a new revenue stream for farmers and takes shorter time to mature.
- Case of afforestation should be further emphasised. Farms, institutions and companies with high energy intensity should be compelled to establish their own woodlots for their own wood supply.
- Cost reduction strategies – subsidies or access to affordable credit – should be implemented to bring down the cost of alternative solid fuels wood pellets and briquettes. Access to credit is one crucial element.

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Annex 1: Overview of EF projects directly contributing to mitigation of deforestation

Project number	Title	Country	Type of contribution				
			Stoves	Charcoal production	Tree planting	Alternative biofuels	Biogas
2007/195-954	Community Managed Renewable Energy Program For Rural Ethiopia	Ethiopia	✓				
2007/195-955	HydroBioPower: livelihood improvement in rural area through collaborative development of renewable energy sources in Oromia and Southern Nations Regional States of Ethiopia	Ethiopia					✓
2007/195-964	Best Ray (Bringing Energy Services to Tanzanian Rural Areas)	Tanzania	✓				✓
2008/195-967	Promoting use of sustainable energy in Wajir District	Kenya			✓		
2007/195-974	Somalia Energy and Livelihood Project (SELP)	Somalia	✓				
2007/195-975	Community-assisted Access to Sustainable Energy in Rwanda (CASE-RWANDA)	Rwanda	✓	✓			
2007/195-980	Eco Makala: viabilisation durable de l'approvisionnement en bois-énergie des populations rurales riveraines de la ville de Goma	Congo, The Democratic Republic of the					✓
2007/195-982	Up scaling the smaller biogas Plants for agricultural producers and processors	Kenya					✓
2007/195-984	Providing access to modern energy for northern Uganda (PAMENU)	Uganda	✓				
2007/195-993	Developing energy enterprises project East Africa	Kenya; Tanzania; Uganda	✓				✓
2007/196-002	Msamala Sustainable Energy Project	Malawi	✓	✓	✓		
2007/196-006	Appui à la synergie énergie – environnement dans le sud-ouest de Madagascar	Madagascar	✓				

Project number	Title	Country	Type of contribution				
			Stoves	Charcoal production	Tree planting	Alternative biofuels	Biogas
2011/231-870	The Improved Cook Stoves for Households and Institutions Project	Kenya	✓		✓		
2011/231-887	Provision of efficient, affordable and sustainable energy for cooking and heat to rural households in Eritrea	Eritrea	✓		✓		
2011/232-060	Programme pour l'Energie de Cuisson Economique pour l'Afrique de l'Ouest – ProCEAO	Burkina Faso; Benin; Mauritania; Senegal	✓				
2011/232-616	Promotion du charbon de typha en alternative au charbon de bois (TYPHA)	Mauritania				✓	
2011/264-691	Energies durables dans les régions d'Agadez et de Tilla-béri	Niger	✓				
2011/264-697	Energy for All (E4A) – Alternative Energy Solutions for Rural and Peri-urban Timor-Leste	Timor-Leste	✓			✓	
2011/266-546	Community empowerment for efficient production use and access of renewable and sustainable energy in rural areas in Malawi	Malawi	✓				
2011/267-136	TRIADOS - Expanding Sustainable Energy Markets through Microfinance -Energy Enterprise partnerships	Kenya; Tanzania; Uganda	✓				
2011/268-336	Integrated Approach to Meet Rural Household Energy Needs of Ethiopia	Ethiopia	✓				✓
2011/270-457	Facilidad Sur Solar	Dominican Republic	✓				
2011/270-635	ProgettoMondo Mlal : - Déployer de nouvelles opportunités de développement so-cio-économique par l'accès aux énergies durables dans le Plateau Central	Haiti	✓	✓	✓		
2011/273-991	Programme d'accès aux services énergétiques, Commune rurale SAFO (PASE)	Niger	✓				

Project number	Title	Country	Type of contribution				
			Stoves	Charcoal production	Tree planting	Alternative biofuels	Biogas
2011/275-289	Increase access to efficient stoves among rural households in Northern Uganda	Uganda	✓		✓		
2012/023-215	Improving reliable access to modern energy services through solar PV systems for rural areas (outer islands) of Tuvalu	Tuvalu		✓	✓		
2012/232-680	Sustainable Wood and Charcoal Production in Rural Mozambique and Tanzania	Mozambique; Tanzania	✓				
2014/344-366	Access to energy services in rural and peri-urban areas in Northern Uganda (Teko Wa Project)	Uganda	✓		✓		
2014/344-468	Programme d'implantation et de dissémination de Biodigesteurs dans les zones rurales du Sénégal (PIDB)	Senegal					✓
2014/352-933	Amélioration des conditions de vie des enfants et de leurs familles grâce à un accès à des services énergétiques modernes, propres et abordables dans 30 communautés pauvres du cercle de Kita au Mali	Mali	✓				
2014/353-512	Accès à des services énergétiques modernes et durables au Mali	Mali					✓
2014/353-422	Light Up Liberia	Liberia	✓				
2014/353-458	Light up our Futures	Liberia	✓				

Annex 2: Successful deforestation mitigation in Central Africa Republic

In the 1990s to 2000s, deforestation rates in Central Africa Republic reduced by 50%. This was achieved through enactment of favourable forest management policies and changing socio-economic factors. The ongoing urbanisation brought about by extraction of oil and mineral resources and the subsequent reliance on importation of foodstuff, which competed with locally produced foodstuff, drastically changed the need to clear forests for agricultural production. The higher incomes in the urbanised areas such as Kinshasa drew more population from the rural areas. Unlike the large agro-industry that was prevalent in Latin America and Asia, in Central Africa Republic there was none.

Overreliance on oil and mineral based development led to decline of agricultural led economy. Overall demand for charcoal and fuelwood has grown over time and is restricted to areas in and around cities. Thus, pressure on forests especially near urban centres increased while it dropped in more distant regions.

Programmes dedicated at forest management practices has been initiated across the Congo Basin. For instance, the Congo Basin Forest Partnership (CBFP), which begun in 2002; the Central Africa Regional Program for the Environment, launched with United States Agency for International Development (USAID) funding the following year; and the Congo Basin Forest Fund, established in 2008 with funding from Norway and the United Kingdom. The CBFP brought together different stakeholders such as the governments from the Congo Basin, non-governmental organisations, private sector and international organisations in dialogue to create bridges between funding and implementing entities.

Through these dialogues, CBFP identified 13 priority conservation landscapes covering a total of 700,000km² encompassing important ecological zones and biodiversity “hot spots”. Currently, the CBFP is made up of 21 governments, 12 international organisations, 20 non-profit organisations, and 8 private-sector members.

It is important to highlight that even before these regional programmes started, all the countries in the region had adopted new forest codes during the 1990s, and sequentially, forest management plans were implemented and extended to cover wider forests. In some of the countries in the Congo basin, the extension of forest management was very rapid. In Cameroon, for example, the area covered by forest management plans increased from 1.8 million hectares in 2005 to 5.3 million hectares in 2011, with 1 million hectares already certified by the Forest Stewardship Council (FSC). In Gabon in 2010, 3.5 million hectares of forest had fully developed forest management plans, with additional plans in development for another 6 million hectares. A total of 1.87 million hectares of Gabonese forest were FSC-certified as sustainable—the largest area of any country in Africa.

The gradual establishment of sustainable production-forest management has been one of the major developments in the forest sector in the Congo basin in the last 15 years. Gradually, sustainable forest management approaches have replaced extractive approaches involving intensive logging and inadequate planning.

Adapted from: Boucher D., P. Elias, J. Faires and S. Smith, 2014. Deforestation Success Stories Tropical Nations Where Forest Protection and Reforestation Policies Have Worked. Union of Concerned Scientists.