
Sustainable Charcoal Value Chain Mozambique

**Literature and Field Research
on Sustainable Charcoal Production Options that can
be supported under the framework
of the UN Framework Convention on Climate Change**



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Disclaimer

This report has been prepared in the context of an assignment by the Climate Change Service of the Belgium Federal Government. The Government of Mozambique endorsed this assignment. The findings are the result of fieldwork and literature research by the authors and are meant to serve as a basis for further discussion with the different stakeholders in the charcoal value chain.

The views and opinions expressed in this publication are those of the authors and do not reflect the opinion or views of any other party.

Results and facts have been gathered and cross-checked at the best of our ability. This document will not be updated to address changes in Mozambique such as applicable laws and regulations. Each user of this document is solely responsible for using the contents of this document and verifying its status and applicability.

This report does not provide a Standardized Baseline for Mozambique nor does it fully calculate or assess feasibility of the options in emissions reduction terms according to UNFCCC methodologies. This calculation is part of the Climate Financing Feasibility Study in the next phase.

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Acronyms

ANB	Biomass Energy Agency (non-existent yet)
BEST	national Biomass Energy Strategy
CBNRM	Community-Based Natural Resource Management
CER	Certified Emissions Reduction credit
CDM	Clean Development Mechanism
CIB	Inter-ministerial Commission on Bioenergy
CIFOR	Center for International Forestry Research
CoP	Conference of Parties
CPA	Charcoal Producers Association
CPI	Investment Promotion Centre
DUAT	land rights, Direito de Uso e Aproveitamento da Terra
DNRE	National Directorate for New and Renewable Energy
ESA	European Space Agency
EUEI	European Union Energy Initiative
EIA	environmental impact assessment
FAO	Food and Agriculture Organization
FDI	foreign direct investment
FUNAE	National Energy Fund - Fundo Nacional de Energia
GIS	Geographic information system
GIZ	German Gesellschaft für Internationale Zusammenarbeit
GNI	Gross National Income
GoB	Belgian Federal Government
GoM	Government of Mozambique
Kg	Kilogram
LDC	Least Developed Countries
MCLT	Mozambique Carbon Livelihoods Trust
ME	Ministry of Energy
MICOA	Ministry of Coordination of Environmental Action
MINAG	Ministry of Agriculture, includes Forest Department
MRV	measurable, reportable and verifiable
NAMA	Nationally Appropriate Mitigation Action
NGO	Non-governmental organization
NLP	National Land Policy
ODA	official development assistance
PoA	Program of Activities of CDM
PROBEC	Program for Basic Energy and Conservation in Southern Africa.
REDD	Reduced Emissions from Deforestation and forest Degradation
SB	Standardized Baseline
SFM	Sustainable Forest Management
SNV	Netherlands Development Organization
UNFCCC	United Nations Framework Convention on Climate Change
VER	Verified or Voluntary Emission Reduction unit
WISDOM	Woodfuels Integrated Supply-Demand Overview Mapping
WB	The World Bank

Preface

The Belgian federal government is committed to supporting least developed countries' participation in the Clean Development Mechanism (CDM) and to supporting their efforts in contributing to climate change mitigation in general.

After a scoping study on opportunities for programmatic CDM and further consultations with Mozambican stakeholders, the Belgian Federal Government decided to support the identification of opportunities for the charcoal production sector in Mozambique to benefit from climate financing, either through the Clean Development Mechanism or the Nationally Appropriate Mitigation Action (NAMA) framework.

The activities to be developed should be in line with and contribute to the goals of Mozambique and to the Energy and Environment Policies of the Mozambican Government.

Sumário Executivo

Na sequência de um estudo exploratório sobre as oportunidades do Mecanismo de Desenvolvimento Limpo (MDL) programático e outras consultas realizadas com partes interessadas em Moçambique, o Governo Federal Belga decidiu apoiar a identificação de oportunidades no sector de produção do carvão vegetal em Moçambique a beneficiarem de financiamento climático, quer através do MDL quer através do quadro da Ação de Mitigação Nacionalmente Apropriada (NAMA).

O presente relatório apresenta os resultados da pesquisa bibliográfica e um breve estudo de campo sobre o sector do carvão vegetal em Moçambique conduzido entre os meses de Setembro e Dezembro de 2013. Baseando-se no objetivo desta iniciativa, a principal pergunta da pesquisa é: *“Como é que o sector de produção do carvão vegetal em Moçambique pode se desenvolver de modo a beneficiar de financiamento climático, seja através do MDL seja através do quadro de NAMA”*.

As medidas (a serem) identificadas deverão ser exequíveis e adequadas em primeiro lugar numa perspetiva de desenvolvimento sustentável (económica, social e ecológica) e em segundo lugar numa perspetiva financeira. Isso tornará possível identificar ações promissoras independentemente de que fonte de financiamento será disponibilizado para transpor os obstáculos.

Análise do problema

- o O uso de lenha e do carvão vegetal para cozinhar reduziu de 85% em 2011 (Relatório de Avaliação de Energia Limpa (*Clean Energy Assessment Report*)) para 80% (BEST, 2012) mas até aqui ainda continua substancial.
- o O consumo total de biomassa por famílias e no sector comercial é estimado em 14 milhões de toneladas (WISDOM, 2008).
- o No papel, as leis nacionais esperam um sector de carvão vegetal sustentável e bem regulamentado, assim como investimentos de nível industrial. A implementação e a aplicação são mais difíceis, sendo que o sector do carvão vegetal é predominantemente informal.
- o A degradação florestal é um motivo de grande preocupação para o país como resultado do abate de árvores das três espécies mais valiosas, conversão para a produção agrícola, alternância entre o cultivo, queimadas de florestas e a produção de carvão vegetal (CIFOR 2012). A *European Space Agency (ESA)* afirma que 42% encontra-se até certo ponto degradado e que 19% do solo apresenta degradação em andamento. O maior nível de desflorestamento e degradação florestal como resultado da produção de carvão vegetal é notado nas províncias da zona sul de Moçambique, as quais fornecem ao principal mercado Maputo.
- o Por todo o país, muitos produtores não se encontram organizados e não possuem uma licença, sendo que podem ser considerados ilegais ou informais. Segundo a análise do país do BEST (BEST, 2012), acredita-se que somente 5% do atual sector do carvão vegetal seja formal.

Contexto das políticas

- o O Governo de Moçambique decidiu elaborar uma Estratégia de Energia a Partir da Biomassa, sendo que se encontra a conduzir um processo interno com vista a

formular a sua estratégia de biomassa. Os objetivos específicos desta nova estratégia incluem:

- Introduzir alternativas de energia como substitutas da lenha e do carvão vegetal;
 - Desencorajar o uso de combustíveis convencionais da biomassa como fonte primária de energia;
 - Reforçar a capacidade das instituições quanto ao controlo da cadeia de valor do carvão vegetal e da lenha (nota: este objetivo pode ser suportado por uma NAMA).
- o Ficou claro a partir de uma entrevista com o Ministério da Energia que o governo tem consciência de que a atual estrutura informal da cadeia de valor do carvão vegetal está demasiadamente complicada para se regularizar e reestruturar de modo a evitar os efeitos negativos da degradação florestal e a produção de subsistência do carvão vegetal. O GdM pretende regularizar o sector dando um maior papel ao sector privado de modo a que este possa tornar a cadeia de valor do sector mais comercial e possa ter mais controlo sobre o desflorestamento.

Cadeia de Valor do Carvão Vegetal

- o O resultado mais óbvio e promissor a ser alcançado por meio do uso do financiamento climático com vista a melhorar o sector do carvão vegetal é a partir de (1) design melhorado do forno e (2) gestão florestal. Outras medidas conduzem a reduções de emissão numa forma indireta, as quais têm muitas vezes importância igual e têm um impacto numa escala maior/mais ampla.

Gestão Florestal

- o Não há até agora exemplos de sucesso em Moçambique no que toca à gestão florestal sustentável. De forma geral, os produtores de carvão vegetal – em especial aqueles sem nenhuma posse individual ou comunitária – não mostram interesse pelos procedimentos de gestão florestal.
- o Formalmente, os produtores do carvão vegetal devem ter *Licença de Exploração Florestal*. Essa licença determina os limites de produção bem como as três espécies usadas. Os troncos têm de ser cortados a uma altura de 35cm acima do solo para permitir o recrescimento. A autorização define um bloco de exploração limitando deste modo (teoricamente) a área de produção geral.
- o A monitoria por parte do Governo é limitada devido ao fato de se ter de monitorar áreas extensas e pelo fato de haver falta de extensionistas (Falcao et al. 2012).
- o As duas Associações de Produtores de Carvão Vegetal (CPAs) visitadas – com membros que têm uma licença para um bloco de exploração específico – estão preocupadas com a sustentabilidade do seu fornecimento de madeira e as práticas de gestão florestal. Para determinar se as outras CPAs se encontram organizadas numa forma similar e apresentam a mesma preocupação, será realizado um estudo de viabilidade na próxima fase desta iniciativa.
- o Na província de Gaza, os produtores afirmam que para o recrescimento a uma dimensão de produção da árvore Mopani são necessários cerca de 20 anos. A Bibliografia (Cunningham, 1996) sugere uma taxa de crescimento do diâmetro de Mopani de 590 mm por ano. Isso irá sugerir árvores razoáveis aos 4-5 anos. A diferença não foi pesquisada mas pode ter a ver com a disponibilidade de água

e nutrientes. Deve-se dar mais atenção a isto antes de o tamanho de um 'bloco de exploração sustentável' ser determinado.

- o Um Bloco de Exploração legal e sustentável pode ser 132-166 ha por produtor assumindo que o recrescimento leva 4-5 anos. Naturalmente, o tamanho aumenta se o recrescimento levar mais do que 5 anos. Com uma produção mais eficiente, a área necessária reduz-se. Segundo os produtores locais, eles necessitariam de 150-200 ha.

Produção de Carvão Vegetal: fornos eficientes

- o Os produtores de carvão vegetal podem ser subdivididos em (1) os titulares de licença formal de produção do carvão vegetal os quais por seu turno empregam pessoas que recebem um pagamento mensal pela produção; e (2) aqueles que produzem informalmente por conta própria e vendem os seus sacos 'no portão'.
- o Um produtor individual tem de ter uma licença para a qual ele paga uma taxa de 5 Mt por saco de 70 kg e um produtor pode legalmente produzir o máximo de 1,000 sacos por ano (70,000 kg de carvão vegetal).
- o Um Bloco de Exploração possui 6 a 8 fornos. Duas pessoas manuseiam cada um dos fornos. Um produtor organizado contrata pessoas para manusear o forno de tal forma que cada bloco de exploração emprega 12 a 16 pessoas.
- o O Carvão Vegetal em Moçambique é produzido usando os tradicionais *fornos em terra*, sendo que a sua eficiência é de 10-20% com uma média de 14%: um rácio de conversão de 7 kg de madeira para a produção de 1 kg de carvão vegetal.
- o No local de produção, o preço de um saco de 70 kg é de 250 Mt (vendido em Maputo a 840 Mt). O lucro é partilhado entre o produtor (100 Mt) e os trabalhadores (2x 50 Mt).
- o Um forno de terra melhorado incluiria uma chaminé para controlar o processo de carbonização. Outros modelos, tal como o forno de retorta, podem duplicar a produção mas poucos produtores receberam formação para o uso de fornos melhorados. Não há experiência em redução de metano ou queima nos fornos.
- o Algumas Associações de Produtores do Carvão Vegetal (que chegam a ter mais de 1,000 membros) tiveram formação na província de Gaza, em Mabalane. Os membros têm licenças de produtores individuais. Em todo o país, as CPAs existem em vários níveis de organização e de formalidade.
- o Não há, até ao preciso momento, informação suficiente disponível sobre todas as CPAs potenciais e o seu nível de organização para avaliar se elas podem ser parceiras elegíveis ou viáveis. Sete CPAs parecem estar razoavelmente organizadas, sendo que duas associações de produtores de carvão vegetal foram visitadas na província de Gaza conforme pesquisa de caso: no distrito de Combomune e no distrito de Mabalane. As Associações alocaram a cada um dos membros um Bloco de Exploração específico e elas restringem os membros a usarem somente árvores Mopani e monitoram a taxa de abate das árvores e a taxa de desflorestamento. Essas organizações de produtores pareceram surpreendentemente bem organizadas (em comparação com as visitas a outras comunidades nos anos anteriores), sendo que os membros entrevistados demonstraram um nível sólido de entendimento sobre empreendedorismo e o risco de sobre-exploração.

Potencial de Financiamento climático

- Financiamento a favor do clima pode vir do (1) Programa de Atividades do Mecanismo de Desenvolvimento Limpo (MDL PdA); da (2) Ação de Mitigação Nacionalmente Apropriada (NAMA); da (3) Redução de Emissões resultantes do Desflorestamento e Degradação Florestal (REDD); dos (4) Créditos de carbono voluntários. Os primeiros dois são aqueles levados em conta no contexto desta iniciativa.
- *Mecanismo de Desenvolvimento Limpo*: no contexto do MDL somente algumas metodologias registadas estão relacionadas com o sector do carvão vegetal e ainda existe pouca experiência até agora. Até onde pode ser determinado, nenhum dos projetos registados na UNFCCC emitiu CERs até o momento. A metodologia mais viável para a situação de Moçambique é ACM0021 “Redução de Emissões resultantes da produção do carvão vegetal através de melhoramento do design dos fornos e/ou redução de metano”. Esta metodologia parece viável para ser implementada em Moçambique se uma escala suficiente puder ser organizada.
- *Ações de Mitigação Nacionalmente Apropriadas (NAMAs)* são primariamente concebidas como uma forma de os países em desenvolvimento— com apoio financeiro e tecnológico da comunidade internacional— registarem progressos na redução das suas próprias emissões domésticas. Um plano relativo ao carvão vegetal deverá ser elaborado sob a bandeira das NAMAs. Uma NAMA permite maior flexibilidade do que os projetos do MDL porque não se limitam a metodologias específicas da UNFCCC. A NAMA pode ajudar a organizar as cadeias de valor do carvão vegetal em todo o Moçambique. Por exemplo:
 - ✓ Fazer cumprir a legislação em vigor e a monitoria do governo da produção e transporte.
 - ✓ Apoiar o sistema de licenciamento através da organização e estabelecimento legal de novas Associações de Produtores do Carvão Vegetal em outras províncias.
 - ✓ Estabelecer blocos de exploração de rotação sustentável e um sistema de gestão para os produtores do carvão vegetal bem como introduzir metodologias melhoradas que conduzam diretamente a reduções de emissões (uso de madeira seca, forno em terra melhor a ser seguido pelos fornos melhorados).
 - ✓ Apoiar a planificação do uso das florestas e o zoneamento de áreas de produtores do carvão vegetal pelo governo e a proibição e aplicação (também através de monitoria por satélite) em outras áreas.
 - ✓ Estabelecer um quadro de política e condições legais sob os quais as plantações de florestas poderão produzir carvão vegetal para os consumidores e/ou a indústria.
 - ✓ Desenvolver uma Marca formalizada (controlada e emitida por uma organização) e um marketing de apoio dirigido aos consumidores urbanos de modo a aumentar a sensibilização e as vendas.
- Co-benefícios – importantes para uma NAMA – podem ou devem ser alcançados através do aumento da produção do carvão vegetal (a serem quantificados na próxima fase): (1) Geração de renda para os produtores licenciados e os seus empregados; (2) Efeitos económicos sobre as comunidades relacionadas; (3) Efeitos de saúde resultantes dos fornos melhorados e operações melhoradas; (4) Efeitos ambientais e sobre a biodiversidade resultantes da

redução da degradação florestal; (5) Efeitos sobre o empoderamento da mulher (género).

- o A implementação de um projeto com o financiamento climático no sector do carvão vegetal em Moçambique irá encarar de qualquer forma desafios importantes de Monitoria, Prestação de Contas e Verificação.

Solução: potenciais modelos de negócio.

Todos os modelos mais promissores apresentados adiante incluem formas de cooperação entre produtores, empresas e o governo. Por favor, note que uma oportunidade não exclui necessariamente a outra.

1. Associações de Produtores do Carvão Vegetal (CPAs)

- o *As Associações de Produtores do Carvão Vegetal (CPAs)* existem em Moçambique e estão implantadas nas comunidades e têm / podem ter direitos legais para com a terra (sob o DUAT). Sete delas parecem capazes, bem organizadas e em controlo.
- o Produtores expressam que são empresários individuais e que têm responsabilidade por um Bloco de Exploração. Eles querem responsabilidade e prestação de contas individuais e mostram uma disposição para eles próprios investirem, significando que dentro duma Associação alguns indivíduos tornar-se-ão bem-sucedidos, outros não. Isto tem de ser examinado no workshop e com todos os membros de uma CPA.
- o A experiência com os projetos comunitários fracassados sugere que certas pré-condições precisam de ser satisfeitas antes de se tentar implementar um projeto:
 1. Cada membro individual devia ter direitos de uso legais e herdáveis de acordo com o DUAT.
 2. Um nível já oficializado de organizações já se encontra presente mostrando que os produtores querem cooperar uns com os outros i.e. as Associações de Produtores do Carvão Vegetal têm de existir e têm de ser funcionais. A Associação tem de demonstrar que ela alocou blocos de exploração aos seus membros e deve monitorar a implementação e as licenças. Os membros prestam contas a cada um deles e ao governo.
 3. Os membros têm de provar que eles gerem um negócio financeiramente viável de produção de carvão vegetal.
 4. A floresta está atualmente a degradar-se e os produtores sentem a pressão económica do uso não sustentável e a viabilidade do seu negócio.
 5. Não há ainda exemplos de sucesso em Moçambique respeitante à gestão sustentável de florestas. Daí os membros têm de encarar problemas de disponibilidade de árvores dentro do seu bloco de exploração e estão cientes de que esta prática não pode continuar. Eles aceitam que as práticas de gestão sustentável de florestas e o replantio são necessários.
 6. O recurso é/pode ser limitado por uma licença e alocando blocos de exploração herdáveis a titulares de licenças individuais;
 7. Os fornos melhorados não deviam ser uma operação comunal mas sim a responsabilidade de membros individuais com um forno fixo por bloco de exploração. Além disso, eles podem usar alguns fornos em terra tradicionais cujo desempenho pode ser melhorado com a adição de chaminés. Isso irá introduzir alguma competição entre os membros, pois alguns não

conseguirão manter estas operações e os outros irão prosperar (provavelmente aqueles que sejam mais empreendedores).

2. Plantações de florestas pertencentes a Empresas ou ao Governo (com ou sem pequenos produtores vinculados)

- o Empresas que possuem *plantações de florestas* em Moçambique não têm experiência na produção do carvão vegetal. Muitas plantações plantam pinheiro e eucalipto. É provável que elas não queiram produzir o carvão vegetal mas sim árvores destinadas ao fornecimento de madeiras para construção e pasta para o fabrico de papel.
- o Nenhuma das plantações usam espécies nativas e não se vinculam aos pequenos produtores. Algumas plantações foram criticadas por usarem mais terreno do que aquele alocado a elas no DUAT. Desafios relativos ao estabelecimento de plantações de florestas:
 - O Pinheiro e o Eucalipto crescem mais rapidamente do que as árvores nativas mas são menos adequadas para a produção do carvão vegetal. A licença devia portanto somente permitir o plantio de árvores nativas, ou então a plantação venderia a Madeira a outros mercados;
 - A plantação tem de obter um DUAT- licença para fazer uso do terreno para fins comerciais e tem de certificar-se de ter um acordo claro com as comunidades locais. Recomenda-se a Planificação do Uso da Terra com o mapeamento comunitário por forma a evitar conflitos de limites de terra.
 - As plantações deviam evitar regiões com elevado nível de pastagem de gado ou os herbívoros selvagens (como os elefantes). Eles comerão as sementeiras se não estiverem protegidas.
 - As queimadas descontroladas são frequentes e destruirão árvores jovens. As pessoas frequentemente fazem queimadas nos terrenos de pastagens de modo a afastarem animais e a preparar áreas para a produção de culturas. Isso pode rapidamente descontrolar-se. É necessário criar corta-fogos em volta das plantações. Em segundo lugar, as árvores nativas de Miombo podem sobreviver a incêndios em florestas e conseguem crescer novamente de forma relativamente rápida.
 - Roubo de árvores (derrube ilegal de árvores) é outra preocupação quando a plantação se encontra madura. Contudo, em grandes plantações isto torna-se insignificante.
- o Por outro lado, uma empresa consolidada pode produzir numa escala e com uma eficiência que pode ter um impacto significativo nas reduções das emissões e no mercado. Dado o contexto Moçambicano e para evitar especulação de terras, é importante que um investidor seja uma empresa bem estabelecida e respeitável. Quando as plantações florestais respeitam as preocupações levantadas elas podem ser socialmente aceites, sustentáveis e provavelmente comercialmente viáveis.

3. Provedor de tecnologia para fornos eficientes para as CPAs

- o Torrefação é uma tecnologia de carbonização moderna e atrativa que conduz à redução de necessidades de matéria-prima bem como a um processo mais rápido (de semanas a horas).
- o O custo da tecnologia de torrefação encontra-se atualmente fora do alcance financeiro da maior parte dos produtores do carvão vegetal. Em segundo lugar, muitos produtores atualmente fazem a venda 'no portão'. Isto cria uma

oportunidade comercial para que uma empresa se integre na cadeia de valor do carvão vegetal na qualidade de provedor de tecnologia no que toca a fornos eficientes. Por exemplo:

- Uma grande instalação central de torrefação é criada dentro do espaço comunitário. Os produtores do carvão vegetal podem trazer as suas matérias-primas (dos seus blocos florestais individuais) para esse local para efeitos de torrefação. Os produtores pagam por carregamento torreficado, sendo que eles podem empacotar e vender o carvão vegetal a partir deste local centralizado.
 - Pequenas unidades de torrefação são implantadas em blocos de produtores individuais. O produtor pode contratar esta unidade de uma empresa, sendo que ele é treinado sobre o uso da tecnologia e é responsável pelo seu funcionamento. Ou o produtor contrai um empréstimo para esta unidade e um sistema de pagamento de parcelas cobre os custos da unidade ao longo do tempo. Porque o produtor encontra-se limitado a uma certa quantidade legal, isto significa que ele/ela poupará tempo que poderá ser usado para outros propósitos. Ele/ela não pode produzir mais. A primeira opção parece, portanto, mais realista.
- o Outra opção é a empresa comprar a matéria-prima aos produtores e vender a retalho o produto torreficado nas zonas urbanas. Os produtores aceitariam esta opção somente se a empresa pagasse mais do que eles ganhariam (mais transporte será necessário, mas menos pessoal presente no campo para gerir os fornos em terra). Se for aceitável pelas comunidades e produtores locais, esta abordagem traz muitos benefícios, nomeadamente:
- A introdução de uma tecnologia de carbonização eficaz para os produtores que de outra forma não podiam obter isso. A empresa financia a tecnologia e assume os riscos deste investimento;
 - A certeza de manutenção do equipamento, tendo em conta que é do interesse da empresa ter uma produção contínua;
 - Uma nova marca de carvão vegetal sustentável passa a estar disponível no Mercado, provavelmente a preços competitivos mas sem empurrar os produtores atuais para fora do mercado;
 - Os atuais produtores estão integrados numa cadeia de valor sustentável do carvão vegetal;
 - Monitoria e conformidade com os requisitos de financiamento do carbono são exequíveis, como um resultado de uma produção e dum programa de fornecimento estruturados.

4. Briquetagem de resíduos e Serviços de Desenvolvimento do Negócio

- o O uso de resíduos agrícolas não é comercialmente exequível. Resíduos florestais a partir de pinheiro e eucalipto e operações florestais podem ser uma fonte para a briquetagem. Neste momento, os resíduos não são usados para fins comerciais.
- o A atual prática de produzir carvão vegetal deixa uma elevada quantidade de carvão pequeno no campo. Estes pedacinhos podem ser recolhidos e comercializados para os consumidores mais pobres das zonas urbanas ou podem ser usados para produzir briquetes. Isso poderá ser feito somente se combinado com outras atividades junto às CPAs porquanto os fornos de maior eficiência reduzirão a quantidade dos pedacinhos. Esta atividade representa assim algo extra mas pode ser organizado como uma atividade importante em

favor dos pobres através da inclusão de grupos vulneráveis (por exemplo: as mulheres) de dentro da comunidade. Esta atividade exigirá um acordo de partilha de receitas que seja aceite pelos grupos comunitários bem como pelo proprietário dos fornos.

- o *Serviços de Desenvolvimento do Negócio de Carvão Vegetal*: O envolvimento de empresas e pequenos empresários devia ser estimulado para que se desenvolvam serviços de suporte tal como a transferência de tecnologias ligada a (1) Viveiros da árvore Mopani; (2) Eficiente tecnologia de fornos e transferência de conhecimentos especializados; (3) tecnologia de redução do metano e queima; (4) microcréditos aos produtores do carvão vegetal; (5) Monitoria e prestação de contas por consultores/empresas independentes e certificadas.

Entidade-Mãe necessária

- o Dados os grandes desafios de implementação e todas as tentativas fracassadas até agora, pensamos que um projeto para melhorar a sustentabilidade no sector do carvão vegetal não devia ser meramente outro projeto que implementa um novo modelo. Desde o princípio deve-se envolver todas as partes interessadas-chave para assegurar comprometimento a longo prazo. Uma Parceria Tripartida que inclui o governo (Público), empresas (Privado) e as Associações de Produtores do Carvão (Pessoas) parece ser um modelo de cooperação atrativo.
- o Há necessidade de se ter uma entidade ligada ao governo que apoie o desenvolvimento de um sector do carvão vegetal sustentável. Em geral, essa organização tem de:
 - Ser uma entidade legal para poder receber financiamento climático e outros fundos oficiais;
 - Organizar a cadeia de valor e estabelecer uma situação de igualdade;
 - Assegurar que a produção não infrinja os direitos das pessoas (DUAT) e seja sustentável (não haja degradação florestal, Balanço GEE positivo);
 - Apoiar a gestão de marca e o marketing do carvão vegetal sustentável;
 - Capaz de distribuir fundos numa forma apropriada com base numa avaliação de elevada qualidade das propostas dos projetos submetidos com base em critérios pré-definidos;
 - Porque a ambição é estabelecer uma cadeia de mercado sustentável e economicamente viável, as propostas não deviam ser baseadas no subsídio de 100% mas sim deviam ser baseadas num conjunto de princípios relativos à contribuição própria em % (em dinheiro ou em espécie) e/ou re-pagamento de empréstimos (fundo auto-renovável?).

Impacto

- o *Relevância climática*: É permitido a um produtor do carvão vegetal produzir 70 toneladas de carvão vegetal por ano. Produção atual igual a $2.674 \text{ t CO}_2\text{e}$ (de CO_2) + $9,574 \text{ t CO}_2\text{e}$ (de 455.896 t CH_4) = $9,577 \text{ t CO}_2\text{e}$ / por produtor / por ano. Uma CPA pode incluir 1,000 produtores e conseqüentemente iguala a aproximadamente $9.6 \text{ kt CO}_2\text{e/ano}$.
- o *Cobertura florestal local e nacional*: A estimativa de que as 472,000 famílias de Maputo-Matola por si só consomem entre 139,000 – 297,360 toneladas de carvão vegetal por ano para as quais 0.9 - 2 milhões de toneladas de madeira (numa média de um rácio de 7:1) são necessárias. Qualquer melhoramento em termos de eficiência de produção e a monitoria das licenças em conformidade com as

preocupações, significará que menos árvores serão abatidas. Dada a enorme quantidade de árvores usadas para produzir este carvão vegetal, isso teria um enorme impacto e reduziria a degradação florestal não só a nível local como também à escala nacional. Um ganho em eficiência de 20% significaria 0.18-0.4 milhões de toneladas de madeira ou 0.6 -1.2 milhões de árvores Mopani a menos por ano a abater (estimativa de 0.3 toneladas por árvores de Mopani de 25 cm).

- *Economia de Nível Nacional:* Um aumento em termos de eficiência para 40% (2.5:1) significa que madeira a menos é necessária. Partindo do princípio que todas as sete CPAs organizadas se tornam envolvidas e elas têm uma média de 1,000 membros, estes 7,000 membros produzem 7 milhões de sacos de 70 kg cada ano. Isso representa 490,000 toneladas de carvão vegetal. O melhoramento em eficiência significa que é necessário 1.6 milhões de toneladas a menos de madeira.

Executive summary

After a scoping study on opportunities for programmatic Clean Development Mechanism (CDM) and further consultations with Mozambican stakeholders, the Belgian Federal Government decided to support the identification of opportunities for the charcoal production sector in Mozambique to benefit from climate financing, either through the CDM or the Nationally Appropriate Mitigation Action (NAMA) framework.

The current report presents the results of the literature research and short field study on the Mozambican charcoal sector conducted between September and December 2013. Based upon the objective of this initiative the main research question is: *“How could the charcoal production sector in Mozambique evolve in order to benefit from climate financing, either through the CDM or the NAMA framework”*.

The measures (to be) identified should be feasible and adequate from a sustainable development perspective (economic, social and ecological) first and from the financing perspective second. This will make it possible to identify promising actions regardless from what source financing will become available to tackle obstacles.

Problem analysis

- The use of fire wood and charcoal for cooking decreased from 85% in 2011 (Clean Energy Assessment Report) to 80% (BEST, 2012) but is thus still substantial.
- The total consumption of biomass by households and in the commercial sector is estimated at 14 million tonnes (WISDOM, 2008).
- On paper, the national laws allow for a well-regulated sustainable charcoal sector, as well as industrial level investments. Implementation and enforcement are more difficult and the charcoal sector is pre-dominantly informal.
- Forest degradation is a major issue for the country as a result of logging of the most valuable tree species, conversion for agricultural production, shifting cultivation and forest fires, and charcoal production (CIFOR 2012). The European Space Agency (ESA) states that 42% is to some extent degraded and 19% of land shows on-going degradation. The greatest level of deforestation and forest degradation as a result of charcoal production is noticed in the provinces in Southern Mozambique, supplying the main market Maputo.
- Throughout the country, many producers are not organized and do not have a license and can be considered illegal or informal. According to the BEST country analysis (BEST, 2012), only 5% of the current charcoal sector is thought to be formal.

Policy context

- The Government of Mozambique has decided to design a national Biomass Energy Strategy and is conducting internal process to formulate their biomass strategy. The specific objectives of this new strategy include:
 - To introduce energy alternatives as to substitute firewood and charcoal;
 - To discourage the use of conventional biomass fuels as primary energy source;

- To reinforce the capacity of institutions in the control of the charcoal and firewood value chain (note: this objective could be supported by a NAMA).
- From an interview with the Ministry of Energy it became clear that the government realizes that the current informal set-up of the charcoal value chain is too complicated to regularize and restructure in order to avoid the negative effects of forest degradation and subsistence charcoal production. The GoM aims to regularize the sector with a greater role for the private sector to make the sector value chain more commercial and to get more grip on deforestation.

Charcoal Value Chain

- The most obvious and promising result to be achieved by using climate financing for improving the charcoal sector is direct emissions reductions from (1) improved kiln design and (2) forest management. Other measures lead to emission reductions in an indirect manner, which are often of equal importance and have an impact on a higher/wider scale.

Forest Management

- There are yet no successful examples in Mozambique with sustainable forest management. In general, charcoal producers - especially those with no individual or communal ownership - do not show concern for forest management procedures.
- Formally, producers of charcoal need a Forest Exploitation licenses (*Licença de Exploração Florestal*). This license determines the boundaries of production as well as the tree species used. Stems have to be cut at 35cm above ground for re-growth. The permit defines an exploitation block so it also limits (in theory) the overall production area.
- Government monitoring is limited due to the large areas needed to monitor and shortage of extension staff (Falcao et al. 2012).
- The two visited Charcoal Producer Associations (CPAs) - with members having a license for a specific exploitation block - are concerned at the sustainability of their wood supply and forest management practices. Whether the other CPAs are organised in a similar way and show the same concern has to be determined during the feasibility assessment in the next phase of this initiative.
- In Gaza province the producers state that re-growth to a production-size Mopani tree takes about 20 years. Literature (Cunningham, 1996) suggests an average diameter growth rate of Mopani at 590 mm per year. That would suggest size-able trees at 4-5 years. The difference is not researched but may be related to the availability of water and nutrients. This needs further attention before the size of a 'sustainable exploitation block' is determined.
- A legal, sustainable Exploitation Block could be 132 -166 ha per producer assuming the re-growth takes 4-5 years. Of course the size increases if the re-growth takes longer than 5 years. With a more efficient production the area needed is reduced. According to local producers they would need 150-200 ha.

Charcoal production: efficient kilns

- The charcoal producers can be sub-divided into (1) The formal charcoal production license holders who in turn employ people who receive a monthly payment for production; and (2) those who produce informally on their own account and sell their bags 'at the gate'.

- An individual producer has to have a license for which he pays a fee of 5 Mt per 70 kg bag and a producer may legally produce a maximum of 1,000 bags per year (70,000 kg charcoal).
- An Exploitation Block has 6 to 8 kilns. Two persons operate each kiln. An organised producer hires people to operate the kiln so each exploitation block employs 12 to 16 people.
- Charcoal in Mozambique is produced by using traditional *earth kilns* and their efficiency is 10-20% with an average of 14%: a conversion ratio of 7 kg of wood for the production of 1 kg charcoal.
- At the production site the price of a 70 kg bag is 250 Mt (sold in Maputo at 840 Mt). The profit is shared between producer (100 Mt) and workers (2x 50 Mt).
- An improved earth kiln would include a chimney to control the carbonization process. Other designs, like a retort kiln, can double production but few producers have received training in the use of improved kilns. There is no experience with methane abatement or flaring at the kilns.
- Some Charcoal Producers Associations (can have more than 1,000 members) have been formed in for example Gaza and Mabalane province. Members have individual producer licenses. Throughout the country CPAs exist in various levels of organization and formality.
- There is yet not sufficient information available about all potential CPAs and their level of organisation to assess whether they can be eligible or feasible partners. Seven CPAs seem reasonably organized and two charcoal producer associations were visited in Gaza province as case research: in Combomune district and in Mabalane district. The Associations have allocated each member a specific Exploitation Block and they restrict members to only using Mopani trees and monitor logging and deforestation rates. These producer organizations seemed surprisingly well-organized (compared to visits to other communities in previous years) and interviewed members showed a sound level of understanding of entrepreneurship and the risk of overexploitation.

Potential for climate financing

- Climate financing can come from (1) Clean Development Mechanism Program of Activities (CDM PoA); (2) Nationally Appropriate Mitigation Action (NAMA); (3) Reduced Emissions from Deforestation and forest Degradation (REDD); (4) Voluntary carbon credits. The first two are the ones considered under this initiative.
- *Clean Development Mechanism*: Under the CDM only few UNFCCC registered methodologies concern the charcoal sector and there is little experience yet. As far as can be determined, none of the registered projects at UNFCCC have so far issued CERs. The most feasible methodology for the Mozambican situation is ACM0021 "Reduction of emissions from charcoal production by improved kiln design and/or abatement of methane". This methodology seems feasible to implement in Mozambique if sufficient scale can be organized.
- *Nationally Appropriate Mitigation Actions* (NAMAs) are primarily conceived as a way for developing countries—with financial and technological support from the international community—to make progress in reducing their own domestic emissions. A charcoal-related plan may be developed under the flag of NAMAs. A NAMA allows more flexibility than CDM-projects because they are not limited to specified UNFCCC methodologies. The NAMA could help to organise the charcoal value chains throughout Mozambique. For example:

- ✓ Enforce current legislation and government monitoring of production and transport.
- ✓ Support the licensing system by organisation and legal establishment of new Charcoal Producer Associations in other provinces.
- ✓ Establish sustainable rotation exploitation blocks and management system for charcoal producers and introduce improved methodologies that directly lead to emissions reductions (use of dried wood, better earth kiln to be followed by improved kilns).
- ✓ Support the forest use planning and zoning of charcoal producer areas by the government and prohibition and enforcement (also through satellite monitoring) in other forest areas.
- ✓ Establish a policy framework and legal conditions under which forest plantations can produce charcoal for consumers and/or industry.
- ✓ Develop a formalised Brand (controlled and issued by one organization) and supportive marketing towards urban consumers to enhance awareness and sales.
- Co-benefits –important for a NAMA - can or should be achieved by improving the charcoal production (to be quantified in the next phase): (1) Income generation for the licensed producers and their employees; (2) Economic effects on the related communities; (3) Health effects of improved kilns and operations; (4) Environmental and biodiversity effects of reduced forest degradation; (5) Effects on women empowerment (gender).
- Implementing a project with climate financing in the charcoal sector of Mozambique will face in any case important Monitoring, Reporting and Verification challenges.

Solution: potential business models.

The most promising models presented below all include ways of co-operation between producers, companies and government. Please note that one opportunity does not necessarily exclude the other.

1. Charcoal Producer Associations (CPAs)

- *Charcoal Producer Associations (CPAs)* exist in Mozambique that are rooted in the communities and have / can have legal land rights (under DUAT). Seven of them seem capable, well-organised and in control.
- Producers express they are individual entrepreneurs that have the responsibility for one Exploitation Block. They want individual responsibility and accountability and show a willingness to invest themselves, meaning that within one Association, some individuals will become successful, other will not. This has to be checked at the workshop and with all members of a CPA.
- The experience with the failed community projects suggests that certain pre-conditions have to be met before a project can be attempted:
 8. Each individual member should have legal, inheritable user rights according to DUAT.
 9. An established level of organisations is already present showing producers want to co-operate with each other i.e. Charcoal Producer Associations have to exist and be functional. The Association has to show that it has allocated exploitation blocks to its members and monitors implementation and licenses. The members show accountability towards each other and government.

10. The members have to show that they run an already financially viable charcoal making business.
11. The forest is currently degrading and producers feel the economic pressure of un-sustainable use and the viability of their business.
12. There are yet no successful examples in Mozambique with sustainable forest management. Thus the members have to encounter problems with the availability of trees within their exploitation block and are aware that this practice cannot continue. They accept sustainable forest management practices and re-planting are needed.
13. The resource is/can be limited by a licence and by allocating, inheritable exploitation blocks to individual license holders;
14. Improved kilns should not be a communal operation but rather the responsibility of individual members with one fixed kiln per exploitation block, In addition they can use some traditional earth kilns whose performance can be improved as well by chimneys. This will introduce some competition between members as some individuals will fail to maintain these operations and others will thrive (probably those who are more entrepreneurial).

2. Government or Company owned forest plantations (with and without linked small producers)

- Companies owning *forest plantations* in Mozambique do not have experience with charcoal production. Most plantations plant pine and eucalyptus. It is likely they do not want to produce charcoal but rather timber for construction and pulp for paper.
- No plantation uses native species and they do not link to small producers. Some plantations have been criticized on taking more land than was allocated to them under DUAT. Challenges regarded establishing forest plantations:
 - Pine and Eucalyptus grow much faster than native trees but are less suitable for charcoal production. The license should therefore only allow planting of native trees, otherwise the plantation would sell the wood to other markets;
 - The plantation has to get a DUAT- license to make use of that land for commercial purposes and be sure to have a clear agreement with local communities. Participatory Land Use Planning with community mapping is advised to avoid land boundary conflicts.
 - Plantations should avoid regions with high levels of cattle grazing or wild herbivores (like elephants). They will eat the seedlings if not protected.
 - Uncontrolled fires are frequent and will destroy young trees. People often set fire to the grasslands in order to clear from animals and open areas for crop production. This can quickly spread out of control. It is necessary to clear fire-breaks around plantations. Secondly, native Miombo trees can survive forest fires and re-grow relatively fast.
 - Theft of trees (illegal logging) is another concern once the plantation is mature. However with large plantations this becomes negligible.
- On the other hand, a well-established company can produce at a scale and with an efficiency that can have a meaningful impact on emissions reductions and the market. Given the Mozambican context and to avoid land speculation, it is important that an investor is a well-established and reputable company. When forest plantations meet the raised concerns they can be socially acceptable, sustainable and probably commercially viable.

3. Technology provider on efficient kilns to CPAs

- Torrefaction is an attractive, modern carbonization technology leading to reduced feedstock requirements as well as a faster process (from weeks to hours).
- The cost of torrefaction technology is currently outside the financial reach of most charcoal producers. Secondly, many producers currently sell 'at the gate'. This creates a commercial opportunity for a company to integrate itself within the charcoal value chain as technology provider of efficient kilns, e.g.:
 - One large central torrefaction plant is established within the community grounds. Charcoal producers may bring their feedstock (from their individual forest blocks) to this location for torrefaction. The producer pays per load torrefied, and may package and sell the charcoal from this centralised location.
 - Small torrefaction units are set-up on individual producer blocks. The producer can hire this unit from a company and is trained on how to use the technology, and is responsible for its operation. Or the producer takes a loan for this unit and a payment system of instalments cover the unit costs over time. Because the producer is limited to a certain legal amount it means he/she saves time that can be used for other purposes. He/she may not produce more. The first option seems therefore more realistic.
- Another option is that a company buys the raw material from the producers and retails the torrefied product in the urban areas. Producers would accept this option probably only if the company pays more than they would otherwise earn (more transport needed, but less labour present in the field to manage the earth kilns). If acceptable to communities and local producers, this approach has several benefits, namely:
 - The introduction of an efficient carbonization technology to producers whom otherwise could not afford it. The company finances the technology and assumes the risks of this investment;
 - The assurance of maintenance of the equipment, as it is in the interest of the company to have continuous production;
 - A new brand of sustainable charcoal becomes available in the market, probably at competitive prices but without pushing existing producers out of the market;
 - Existing producers are integrated in a sustainable charcoal value chain;
 - Monitoring and compliance with carbon financing requirements is feasible, as a result of a structured production and supply programme.

4. Briquetting of waste material and Business Development Services

- Use of agricultural residues is not commercially feasible. Forest residues from pine and eucalyptus and logging operations might be a source for briquetting. At the moment the waste material is not used for commercial purposes.
- The current practice of charcoal making leaves a high amount of small charcoal in the field. These small pieces could be collected and marketed targeting poorer urban consumers or could be used to produce briquettes. This can only be done in combination with other activities with CPAs as higher efficiency kilns will reduce the amount of small pieces. This activity is thus an add-on but could be organised as an important pro-poor activity by including vulnerable (e.g. women) groups from the community. This activity would require a revenue-sharing agreement that is acceptable for the community groups as well as the owner of the kilns.

- *Charcoal Business Development Services*: Companies and small entrepreneurs involvement should be stimulated to develop supportive services like the transfer of technology related to (1) Mopani tree nurseries; (2) efficient kiln technology and transfer of expertise; (3) methane abatement technology and flaring; (4) micro-credits for charcoal producers; (5) Monitoring and reporting by independent and certified consultants/companies.

Umbrella entity needed

- Given the huge implementation challenges and all failed attempts so far, we feel a project to enhance sustainability in the charcoal sector should not be merely another project piloting a new model. From the start it should involve all major stakeholders to ensure long-term commitment. A Tripartite Partnership including the government (Public), companies (Private) and Charcoal Producer Associations (People) seems an attractive co-operation model.
- There is a need for a government related entity that supports the development of a sustainable charcoal sector. In general, this organisation needs to:
 - Be a legal entity to be able to receive climate financing and other official funds;
 - Organise the value chain and establish an equal playing field;
 - Ensure production does not infringe on people's rights (DUAT) and is sustainable (no forest degradation, positive GHG-balance);
 - Support branding and marketing of sustainable charcoal;
 - Able to distribute funds in an appropriate manner based upon a high-quality assessment of submitted project proposals based upon pre-defined criteria;
 - Because the ambition is to establish a sustainable economically viable market chain, proposals should not be based on 100% subsidy but rather be based on a set of principles related to a % own contribution (cash or in-kind) and/or repayment of loans (revolving fund?).

Impact

- *Climate relevance*: A charcoal producer is allowed to produce 70 tonnes of charcoal per year. Current production equals 2.674 t CO₂e (from CO₂) + 9,574 t CO₂e (from 455.896 t CH₄) = 9,577 t CO₂e / per producer / per year. One CPA may include 1,000 producers and thus equals approximately 9.6 kt CO₂e/yr.
- *Local and national forest cover*: The estimated 472,000 Maputo-Matola households alone consume between 139,000 – 297,360 tonnes of charcoal per year for which 0.9 - 2 million tonnes of wood (at an average 7 :1 ratio) is needed. Any increase in efficiency of production and monitoring of compliance with issues licenses would mean less trees have to be cut. Given the enormous amount of trees used to produce this charcoal, this would have a huge impact and reduce forest degradation both locally as at national scale. An efficiency gain of 20% would mean 0.18-0.4 million tonnes wood or 0.6 -1.2 million less Mopani trees per year to be cut (estimated 0.3 tonnes per Mopani tree of 25 cm).
- *National level economics*: An efficiency increase to 40% (2.5 : 1) means less wood is needed. Assuming all seven organised CPAs become involved and they have an average of 1,000 members, these 7,000 members produce 7 million bags of 70 kg each year. This is 490,000 tonnes of charcoal. The efficiency increase means 1.6 million tonnes less wood is needed.

1 Introduction

1.1 Introduction to this report

The ultimate objective of the initiative is to *identify opportunities for the charcoal production sector in Mozambique to benefit from climate financing, either through the Clean Development Mechanism (CDM) or the Nationally Appropriate Mitigation Action (NAMA) framework.*

The current report is the final product of the first phase in the assignment, namely the Literature and Field Research. The field research was conducted in September 2013 and interviews were conducted between August and December 2013. This first phase will be followed by a detailed Climate Financing Feasibility Study and assessment with stakeholders (including a workshop in February 2014). The project approach is described in the proposal by EES Engineers and partially amended in a research plan (annex 1).

In order to realize the objective to efficiently implement a project with climate financing – for example a CDM Program of Activities (PoA) or a Nationally Appropriate Mitigation Action (NAMA)- , the assignment and this study need to consider from the start the requirements set by the United Nations Framework Convention on Climate Change (UNFCCC) for these mechanisms, such as the CDM methodologies and monitoring requirements. A second requirement is that the PoA/NAMA should contribute to the objectives of Mozambique and more in particular to the implementation of the Biomass Energy Policy that is under development.

1.2 Reader

In the next chapters the report first starts with explaining the methodology used, the purpose and limitations of this literature and field research study on the charcoal sector. The subsequent paragraphs provide information on issues related to the charcoal sector in Mozambique. Information on the context, i.e. political-economic situation of Mozambique is presented in chapter 3.

This is followed by background information on the charcoal value chain including findings and statistics of field interviews (chapter 4), potential climate financing (chapter 5). Chapter 6 presents potential options for measures that result in emissions reductions. It also presents and discusses several promising 'business models' with charcoal producer associations, companies and the government of Mozambique that can lead to the realisation of these emission reductions.

The final chapter (7) presents findings and recommendations that will be discussed at the workshop of February 2014 and will feed into the detailed study on climate financing.

2 Methodology and definitions

2.1 Main research question of the study

A sound methodology consists of several elements. An important and fundamental element is to use clear definitions in order to avoid multiple interpretations of research data. The definitions used are presented in annex 2. Secondly, various instruments can be used to obtain information and data from various sources. These are presented in annex 6.

The **charcoal value chain** is comprised of five components: forest management, production, transportation, retail and consumption. Sustainable production of charcoal is not a new discussion within Mozambique. Key for this assignment is to use this existing knowledge and to take it to the next practical level. Based upon the objective of this initiative the main research question is:

“How could the charcoal production sector in Mozambique evolve in order to benefit from climate financing, either through the Clean Development Mechanism (CDM) or the NAMA framework”.

2.2 Approach

The approach is presented in the original proposal and research plan and consists of various instruments including a desk study, interviews and a field visit. Throughout the study we have communicated with the Belgian Federal Government and the Government of Mozambique (GoM). GoM ownership is a crucial element for any effective action so the initiative was formally introduced by the Secretariat of State for the Environment of the Belgium Federal Government to the Minister of Environment of Mozambique (23 July 2013). The report will be submitted in January 2014 to the Inter-ministerial Committee on Biofuels and Biomass (CIB - Comissão Interministerial de Biocombustíveis) led by the Ministry of Energy and co-ordinated by CEAPGRI (Ministry of Agriculture). The Ministry of Environment is also represented in this commission. Subsequently, the report and potential options for action will be presented in the February 2014 workshop with the aim to discuss the emission reduction options and business models in more detail.

We have also used peer reviewers – Osvaldo Manso, Claudio Alfonso, Rui Mirara and Ciska Terblanche – that commented on the research plan and draft of this report.

The following stakeholders have been approached for information:

1. *Charcoal Markets and whole-sale yards – Maputo and surrounding production areas*
Interviews with key stakeholders in the charcoal value chain have allowed for a detailed understanding of the charcoal (informal) business. The charcoal markets are spread across the cities of Maputo and Matola. Within each market, a sample of wholesalers, retailers and transporters already have been interviewed.

2. *Ministries*

Key decision makers at the Ministry of Energy, Agriculture and Environment were approached for information of programmes and policies in place for sustainable charcoal production. All ministries are located in Maputo.

3. *Research institutions and universities*

The Agriculture and Forestry Faculty at Eduardo Mondlane University in Maputo is the main institution working with biomass energy. Key experts at these departments were interviewed.

4. *Other institutions dealing with biomass energy and forestry*

Several social groups, NGO's and government agencies have recently begun looking at sustainable biomass energy development in the country. SNV, GIZ, the European commission and the World Bank have been part in several forums on this topic. State institutions such as the National Energy Fund (FUNAE) and the National Agriculture Development Fund have also been actively involved in biomass energy programmes.

5. *Companies*

To the extent possible the operations of some national and foreign companies related to biomass production has been researched. Related to charcoal, the number of companies is very limited: companies that currently stand out: 1) Cleanstar Mozambique, 2) Green Coal, 3) Mozambique Carbon Initiatives, 4) Green Resources. MozCarbon has been interviewed and all will be invited for the 2014 workshop. At the workshop the pros and cons for a climate-financed project and 'willingness-to-invest' by companies will be discussed.

6. *Charcoal Producer Associations and communities*

Mozambique has many legal and illegal producers. Legal producers have organised themselves into Charcoal Producer Associations. These producers should be regarded as entrepreneurs. They can thus both be the target group (beneficiary) of an activity as well as partner in a Partnership. From previous studies some information is available about charcoal production communities. In addition some legal producers have been interviewed to determine their understanding of the economic and forest implications associated with traditional charcoal making; as well as their readiness to adopt sustainable production measures. It is also important to understand their opinions associated with private sector collaboration in charcoal production and commercialization.

In the annexes we provide a stakeholder and literature list.

2.3 Focus of the study

At the start of the study a research plan has been prepared and discussed with the client and peer reviewers. The research questions are presented in annex 1. The essential elements are included in this report. In the context of assessing the feasibility of using climate financing to support a sustainable development of the charcoal value chain the technical, financial and organisational potential of the following emission reduction measures are considered in more detail within the charcoal value chain of Mozambique (see chapters 4 and 6):

- Emission reduction at source of biomass:

- Through use of biomass from sustainable managed forests
- Through use of biomass residues
- Emission reduction in the process of carbonisation:
 - Through methane destruction
 - Through use of improved kilns (and thus efficiency improvements in the charcoaling process).

The chosen study region is the South of Mozambique, namely the Maputo, Gaza and Inhambane Provinces. The region has been chosen due to the following considerations:

1. Within Mozambique the most densely populated region is Maputo Province in the South. The capital Maputo (population 1.6 million) and connected Matola (761,000) is the main consumer market. Thirty-five percent (35%) of the people only use charcoal. An estimated 75% use charcoal as their main fuel even though they also have other stoves at home.¹ The second largest city is Beira with a population of 412,000 (where 90% of the people use charcoal as their main fuel). The charcoal for Maputo comes mainly from Gaza, Maputo and Inhambane Province.
2. Charcoal prices in the cities of Maputo and Matola are the highest within the country. One bag of charcoal is around 70 kg and will last a month in an average household of 5 persons (Atanassov 2012). The price increased from 250 Mt/bag in 2010 to 650 Mt/bag in 2012. Today (Dec. 2013), the price stands at 840 Mt/bag in Maputo.
3. The greatest level of deforestation and forest degradation as a result of charcoal production is noticed in the mentioned provinces in Southern Mozambique, supplying the main market Maputo. Best guess estimates show an annual forest clearance rate of 140,000 ha in the whole country (FAO, 2010). Forest degradation is noticeably higher around cities and in the mentioned provinces (WISDOM study, personal observation and from interviews. See par 4.2.1). The European Space Agency states that 42% is to some extent degraded and 19% of land shows on-going degradation (ESA 2013).
4. Several communities in Southern Mozambique depend on charcoal making for their income and there are not many other economic opportunities. As forest resources dwindle in the region due to over-exploitation, it becomes necessary to engage these communities in sustainable charcoal production and forest management (Atanassov 2012).

2.4 Some basic figures

The literature on the forest sector and charcoal production presents various basic figures to calculate consumption and production. In addition the fieldwork in two charcoal producer communities provided some additional information.

¹ BEST Mozambique (2012). With an average household size of 5 persons this means the Maputo-Matola area has 472,000 households and with 35% of households using one 70kg bag/month/household they consume 11.6 million kg charcoal per month (139,000 tonnes per year). With 75% of households using one bag per month that would be 24.8 million kg per month or 297,360 tonnes per year.

The WISDOM study (GoM 2008):

- Rural consumption of wood varies between 309 kg/person/year (Sofala) to 1095 kg/person/year (Zambezia). The average value used is 695 kg of air dry wood (or 612.5kg oven dry or 0.96 m³).
- Air dry wood contains 12% moisture
- Oven dry wood contains 0% moisture
- Urban dwellers use 1.36 air dry tonne of wood (1.87 m³)
- Average per capita wood consumption ranges between 0.7-1.0 tonne air dry wood or 0.96-1.37 m³.

Brower and Falcao (2001):

- Studied the urban population of Maputo (Chaposa project)
- Average per capita wood consumption (fuelwood and wood for charcoal) of urban inhabitants between 0.92 and 1.0 m³ per year.

BEST Mozambique (2012) and some fieldwork:

- A Mozambican household uses on average one 70 kg bag of charcoal per month.
- Kiln efficiency varies considerably with the use of type of wood and moisture content. The average used for the current earth kilns is 7 kg wood produces 1 kg charcoal.

'Metric ton' is mass equal to 1,000 kilograms and similar to 'tonne' (not to be confused with 'ton' which equals 2,240 pounds or 1,016 kg). In this report 'tonne' is used.

Basic figures related to forest management are provided in paragraph 4.2.1

2.5 Limitations

It is possible to obtain a wide range of information during the data collection period on the current charcoal market and associated environmental and social implications. Information on charcoal production regions and baseline kiln efficiency data is also available. A comprehensive literature review has been done, and where information is missing, further field research will follow. A complete list of charcoal producers association throughout the country is missing in this report as these are in many cases informal and unregistered associations and there not enough information available. GIS and historical satellite images to back up information from the data collection have not been purchased. Some figures and data have been used in this report but satellite imagery is not necessary for this report.

3 The Mozambican political-economic situation relevant for the charcoal value chain

3.1 Social context

Mozambique is one of the land-abundant countries in Africa whereby the majority of people (69% of 25 million people in 2012) still live in rural areas from subsistence farming. Agricultural output in Mozambique consists of crop production (78%), forestry (9%), livestock (7%) and fisheries (6%) (MoZSAKKS, 2011).

Average GNI (Gross National Income) per capita is growing steadily and was US\$ 579 in 2012 or approximately 17,200 MT (World Bank website). According to the Mozambican poverty Reduction Strategy paper (PARP, 2011), informal economic activity (on which the majority of the poor depend) in the cities is predominant, and access to formal employment is still very restricted, particularly for women. There was a notable decline in poverty rates from 69% in 1997 to 54% in 2003 but from 2003 to 2009 poverty rates remained almost unchanged. The PARP 2011-2014 has as its primary goal to reduce the incidence of poverty from 54.7 % in 2009 to 42 % in 2014, with a deliberate decision that government action must first of all promote "pro-poor" growth. If the current overall economic growth rates (above 7%) and agriculture growth rates (above 6%) are sustained, the country still has a chance of reducing the poverty rate to 40% by 2015 as targeted under MDG1. The MozSAKKS study (2011) emphasizes that growth in agriculture and the overall economy should be accompanied by measures that ensure pro-poor, equitable distribution of economic and social benefits.

The main driver for increased charcoal production and use is population growth – and the ongoing urbanization - whereby the households still use traditional biomass. This puts an increased pressure on the resource base and triggers over-exploitation / deforestation. On the other hand, this development also pushes the price of a bag of charcoal higher, which makes alternatives like gas and ethanol as cooking fuel more attractive.

Irrespective of income level, most urban households are connected to the electricity grid whereas in the rural areas most households are still not connected. For cooking mainly fire wood and charcoal are used (see chapter 4). The Clean Energy Assessment Report states that in 2011 the contribution of biomass to the energy balance was about 85%, and more recent work suggests that the level is now around 80% (BEST, 2012). This reflects ongoing heavy dependence on biomass even though many urban households (65% in Maputo) use alternative sources like gas and ethanol (BEST 2012). SNV Mozambique is for example implementing – together with the Municipality of Maputo and GALP – a strategy of 'Gas for the Bottom of the Pyramid', to replace charcoal by Liquefied Petroleum Gas (LPG). The company Cleanstar is promoting ethanol cook stoves. Although these developments are very promising, still the majority of households throughout the country will remain dependent on charcoal the next decade. This merits attention for sustainability and is the purpose of this report.

3.2 Legal context

Mozambique holds one of the most progressive set of laws in Africa, covering a wide-range of sectors and developmental contexts. On paper, the national laws allow for a well-regulated sustainable charcoal sector, as well as industrial level investments. Notable laws and regulations include the countries land law of 1997; the update fauna and forest law of 2003; the environmental law; the climate change legislation and several investment laws and regulations. The Government of Mozambique emphasizes its focus on pro-poor growth and sustainable resource management in various policy documents like the PARP 2011-2014, its land use policy (see below) and the Green Economy Roadmap of June 2012. Emphasis is put on job creation. Charcoal production is one large sector where illiterate people can earn an income or find a job.

Charcoal is a cross-cutting subject and given its economic relevance it is a sector on its own, which is regulated by energy, forestry and environmental policies. However, due to the largely informal nature of the charcoal business, it is difficult to enforce these laws on the ground.

Current legal context charcoal production

The government discourages the use of fuel wood and charcoal and wants to promote modern energy sources and the substitution of traditional fuels with more modern ones such as biogas, briquettes, charcoal from biomass residues and LPG² (especially in small-canisters to be more accessible to the poor).

Biomass energy still accounts for about 80% of the total energy consumed by households provided from about 30.6 million hectares of forests (Ministério da Energia, 2009; BEST 2012). Most existing biomass energy legislation is related to forestry. These are the responsibility of the Ministry of Agriculture (which includes the Forest Department). At national level, the following laws and policies govern the wood-fuel sector (see box below):

Box 1: Legislation relevant for the charcoal sector.

1. *Resolution 10/97 of 7th April (Forestry and Wildlife Policy) [Boletim da República No. 14 – Supp., Series I – 7th April 1997]*

The National Forestry and Wildlife Policy empower local communities to own and participate in the management of natural resources through community-based natural resources management (CBNRM) initiatives (Brouwer and Falcão, 2001).

2. *Law 10/99 of 7th July (Forestry and Wildlife Law) [Boletim da República No. 27 – 4th Supp., Series I – 12th July 1999]*

Forestry and Wildlife Law was approved in 1999, and regulates the basic actions for the protection, conservation and sustainable use of forest resources.

3. *Decree No. 11/03 of 25th March 2003 (amending Decree No. 12/2002 on Forestry and Wildlife Law) [Boletim da República No. 13 – Series I – 26th March, 2003, pp. 78 and 79.*

This Decree provides a new version of articles 20, 21, and 29 of Decree No. 12/2002 on the Forestry and Wild

² LPG = Liquid Petroleum Gas

Fauna Act. In particular, it amends those provisions dealing with licensing procedures and forestry exploitation concessions.

4. *Decree 12/2002 of 6th June 2002 (Regulations of the Forestry and Wildlife Law) [Boletim da República No. 22 – Series I – 6th June, 2002, pp.194(3)-194(27)].*

This Decree consists of 119 articles, acknowledges the existence and the role of local communities on the management of natural resources and allows them to enter into partnership with the private sector in its exploration of natural resources (forestry and wild life).

5. *Ministerial Diploma No. 52-C/2003 of 20th May, 2003 (on forest species used for producing timber) [Boletim da República No. 20 – Series I – 20th May 2003, pp. 160(54) and 160 (55)].*

This Decree deals with commercial trees classification and does not mention any ‘inclusive forestry’ activities.

Formally, the government issues a Forest Exploitation licenses (*Licença de Exploração Florestal*) to the producers of charcoal. This license determines the boundaries of production as well as the tree species used. The Provincial Department of Forestry (resorts under the Ministry of Agriculture, Forest department) issues these licenses. The charcoal producers need to pay a fee of 5 Meticaís for each charcoal bag (70kg) produced. In an attempt to control deforestation the government has stipulated that producers may produce a maximum of 1000 charcoal bags per year. The permit is also linked to an exploitation block so it also limits (in theory) the overall production area. Field staff from the Provincial government have the mandate to regularly visit production regions to make sure that the correct trees are logged for the charcoal production (the permit specifies the species and that stems have to be cut at 35cm above ground for re-growth) and that producers do not exceed their producer license. This however does not always happen in practice, due to the large areas needed to monitor and shortage of extension staff (Falcao et al. 2012).

Those purchasing the charcoal bags also need to obtain a license. Normally it is the transporter of the charcoal, who holds this license and they have to pay 75 Meticaís per bag transported. The local agricultural department has fiscal staff that can check whether truck drivers have a license for the amount of charcoal sacks carried (a truck normally carries between 100 and 150 bags of 70kg). If the transporter carries more sacks than the license permits or does not have a license, than he is fined. This fine is 20,000 Meticaís (667 US\$).³

Table 1: Some Charcoal Producer Associations in Mozambique.

Name production region	Town/district	Province	Remarks
1. Moamanzela	Combomune	Gaza	Visited, well organized
2. Hochane	Mabalane	Gaza	Visited, well organized.
3. Chicualacuála	Chicualacuála	Gaza	Well organized
4. Massingir	Massingir	Gaza	Well organized
5. Jabula	Matutuini	Maputo	Well organized
6. Goba	Boane	Maputo	Well organized
7. Massinga	Massinga	Inhambane	Well organized

³ Interview with Provincial government representative.

Some *Charcoal Producers Associations* (can have more than 1,000 members) have been formed in for example Combomune and Mabalane districts. Members have individual producer licenses. Throughout the country CPAs exist in various levels of organization and formality, which have to be researched in more detail (not within the scope of this report but a recommendation for further study). Seven seem reasonably organized and two charcoal producer associations were visited in Gaza province as case research (interview R. Mirera, SNV): in Combomune district and in Mabalane district. The Associations have allocated each member a specific Exploitation Block and they restrict members to only using Mopani trees and monitor logging and deforestation rates. These producer organizations seemed surprisingly well-organized (compared to visits to other communities in previous years) and interviewed members showed a sound level of understanding of entrepreneurship and the risk of overexploitation.

Throughout the country, many producers are not organized and do not have a license and can be considered illegal or informal. The lack of licensed producers is the result of several difficulties (Atanassov et al, 2012 and Falcao et al 2012): 1) The licensing and fiscal authority have no resources to monitor and control the producers 2) Producers normally reside at long distances from the locations where they could obtain a license (Provincial services of lands and forests); (3) there is no commercial incentive to hold a license.

In general, mainly the transporters or the wholesalers who buy from local producers hold licenses even though also many of them do not have a license (percentages unknown). Although the forest law and its respective regulations state that the producers should be the licensed ones, the current licensing process – i.e. mainly licensing and checking transport - is an attempt to have some control over the charcoal production vis-à-vis the limited capacity of the government (Atanassov et al, 2012 and Falcao et al 2012).

The informality of the charcoal sector is extensive. In 2011, a study launched by the Ministry of Energy and the European Commission compared the estimated consumption of biomass in the cities of Maputo and Matola, to the quantity, which was legally registered under licenses. It was estimated that 1.4 million cubic meters of equivalent biomass was consumed in Maputo and Matola. This figure was five times more than what was officially registered⁴ by the Ministry of Agriculture for 2011 (281,000 cubic meters)⁵. So only 20% was legal. According to the BEST country analysis (BEST, 2012), only 5% of the current charcoal sector is thought to be formal.

Land rights - DUAT (= Direito de Uso e Aproveitamento da Terra)

The Constitution of 1990 recognizes community land rights independently from formal titles and has the potential to provide a high sense of protection to the majority of the rural people. In September 1995 a new National Land Policy (NLP) was approved. The policy intends to establish a clear rights-based approach to guaranteeing land for the poor; it also

⁴ The report does not state whether this was based on the production licenses or on licensing and monitoring transport, or both.

⁵ Fernandes, A. Et al. 2012. "Charcoal and firewood supply to Maputo and Matola Cities" Mozambique Ministry of Energy

aims to be a development instrument designed to promote new investment in the country. The new land law introduced important provisions to secure land rights for rural people, by recognizing customary rights of access and management as being equivalent to the state-allocated land use and benefit rights (DUAT = Direito de Uso e Aproveitamento da Terra). The DUAT may be attributed to all national citizens, international investors (with approved investment proposals), collective entities as well as entire communities. Investors can only lease land for renewable periods up to 50 years. This land license may be revoked by the state, if the entity does not realize the exploration plan for which the property is proposed. Local citizens have a 5-year period to develop a project on the property, while foreign entities have a 2- year period.⁶ A key element is the requirement that investors have to consult local people and secure their approval before they are able to obtain a DUAT. It is important to note that first a discussion and negotiation has to take place, and that the formal and legal re-definition of rights may come later: The law recognizes the informal rights of the poor and gives these rights legitimacy without a need to strictly define them or force them into a rigid legal context. These rights are thus becoming less susceptible to challenge because they have been given a broader legitimacy within the law, rather than as a result of their transformation into a 'formal' rights framework.

Although a favorable legal framework exists, implementation is constrained by the low level of governance (capacity and willingness to monitor and enforce the law) in remote areas and the ease with which rules and regulations can be ignored. In remote rural areas, personal relationships and informal rules matter more than institutions codified in law (legislation does not represent 'the rules of the game' but are just 'part of the game').

The institutionalization of community based management takes much more than just the mapping, re- aligning and registering of tenure and access rights. The administration regulating access to land and resources has to be trusted by the citizens if it is to secure the goodwill and cooperation required for community participation and/or CBNRM (Community-Based Natural Resource Management) to succeed. This is especially the case when discussing the allocation of very large areas to plant a commercial crop. Full commitment and engagement by the poor communities is needed to avoid favoring the politically or economically powerful, as well as rent-seeking behavior by those administering the process. After entering into an agreement, promises made to the communities have to be kept (by the company) and they need to feel supported by their government in case of conflicts (i.e. fair decision-making and rule of law).

Therefore, in the context of assessing potential options for sustainable charcoal production and selecting promising regions and communities, in our opinion the following pre-conditions have to be met:

- The communities, producer associations and companies have legal tenure based upon DUAT;
- The local government representatives are trusted by their constituency;
- Any agreement between communities and companies is based upon Prior and Informed Consent and an impartial authority monitors application.

⁶ Mozambique land law, No 19/97 of 1 October 1997

- Preferably, established Charcoal Producer Associations are present and operational reflecting a certain way of formalised contacts between communities and the government.

Environmental Impact Assessment

Under the Mozambican Environment Law, an environmental impact evaluation is required to determine which type of environmental impact assessment (EIA) is to be carried out (Category A, B or C):

Category A: Is subject to a full Environmental Impact Assessment

Category B: May be subject to a Simplified Environmental Assessment

Category C: Is subject to the norms of good environmental management

The environmental law states that environmental impact assessments are required for the clearance and use of native vegetation on individual or cumulative areas over 100 ha. An EIA is also required for any deforestation activity covering more than 50 ha, reforestation or afforestation of areas covering more than 250 ha.⁷ Such EIAs are prepared and submitted to MICOA for approval. The quality of the EIAs cannot be verified as there not readily available (they are for example not officially published on MICOA's website).

3.3 Political-economic developments

An important element of assessing the feasibility of measures to enhance sustainability in the charcoal sector is the political-economic setting for these interventions.

Government

After independence in 1975, all land and other property was nationalized in Mozambique. Over the years responsibility and decision-making over natural resources became more decentralized. However, capacity and finances lag behind and within the single party state, the top still controls the bottom rather strongly, especially when the economic use of natural resources is at stake. Provincial Governors are appointed by the President, but at district and municipal level elections are held. Districts develop their own development plans with budgets. Community Authorities also have become more important and are responsible to: (1) disseminate government laws and policies to community members; (2) collect taxes; (3) register the population; (4) enforce justice; and (5) mobilize and organize communities for local development activities (Law of Local Organs of the State, 2003). They also have a land management function. However, when a company makes a land application, disputes may arise about which institution is the right one to handle it, mirroring power struggles at various levels. At the lower levels of administration, arrangements and responsibilities are still not clear and often ambiguous.

Politics and government are dominated by Frelimo: the former liberation movement turned into a political party. The party has won the last elections and at the moment strong political opposition is absent. The last decade the government is moving from socialism to capitalism and gives more space to the private sector.

⁷ MICOA, 2007. "The legal framework for environmental licensing in Mozambique"

Foreign direct investment in natural resources is increasing but doing business in Mozambique is difficult. The country lists 132nd out of 183 countries on enforcing contracts (World Bank 2011, Doing Business report) and 65th for starting a new business (6th out of the 46 sub-Saharan Africa countries). Enforcing a contract – especially when it involves an important Mozambican counterpart – takes a very long time and is costly. Most disputes are therefore settled privately or not at all. The business environment is further hampered by bureaucracy, unclear property rights, trade barriers, corruption and a lack of law enforcement and inconsistent applications of regulations. Other negative factors are a lack of infrastructure and the absence of skilled labor. Notwithstanding these constraints foreign direct investments in agriculture and forest plantations has increased. However, given the informal setting of charcoal production and the above-mentioned constraints, this probably means that major investments by foreign companies in the charcoal sector will be limited and at first will depend on companies already present in Mozambique (Mozambican and foreign). This situation can change very fast if conditions become favorable (like the 2008' biofuel boom).

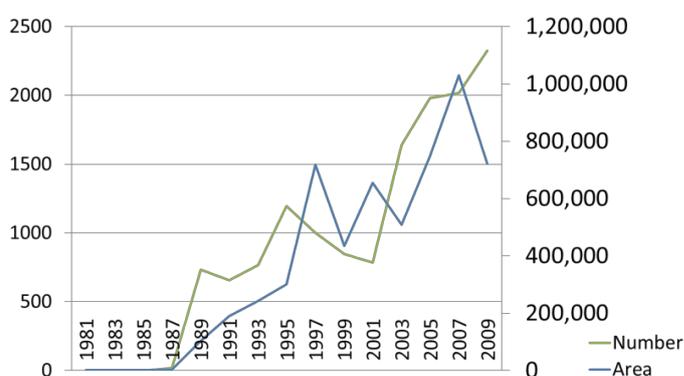
Company investments in Agriculture Value Chains.

CPI (Investment Promotion Centre) data for 2008-2011 indicates a significant increase in investment in the agriculture sector, which represents 51.5% of the total investment value over this period. The main share comes from foreign direct investment (FDI), and a large part comes from South Africa. Investments in agriculture rose from 11% share between 2000-2008 to 51.5% between 2008-2011. Anno 2012, investors are mainly interested in:

- Ethanol from sugar cane (now still mainly sugar) and sweet sorghum;
- Soy
- Cattle ranching
- Biomass from eucalyptus plantations (see below)

Overall, the demand for land still surges (see figure below) and the pressure on land and communities is increasing. This means that charcoal production has to compete more and more with other – often high value- agricultural uses.

Figure 1: Number and area of provisionally authorized rural DUATs in 5 provinces (Manica, Tete, Sofala, Inhambane and Gaza, biannually by year of authorization.



Source: In Sogemo (2012 from DNTF/WB/FAO, 2010

Land allocation versus real economic developments.

There is a discrepancy between announced (i.e. formally accepted investor proposals (by CPI and CEPAGRI) and actually operational projects. This suggests that: (a) investors have problems to actually become fully operational resulting in a significant time-lapse (see also next paragraph); and (b) land speculation may inflate the investment figures.

Land speculation can take several forms. Some investors try to get a land permit in order to sell this permit if land prices rise. They have no intention to actually develop the land. Others have basically a sound investment proposal and acquire a provisional land permit. They lack however sufficient financing and only after they have acquired the permit they approach other investors to finance their proposal. Of course this can take much time during which the land is not developed. After two years the provisional permit can be revoked according to the DUAT.

Company investments in Forest plantations.

Mozambique has some experience with forest plantations. The actually planted forest area was estimated at 62,000 ha by the FAO in 2010. In contrast the number of hectares granted in forest concessions is much higher. There are some initiatives to plant Eucalyptus. Eucalyptus is mainly used for paper and pulp production. Examples are: Norwegian-owned company Lurio Green Resources was granted 126,000 ha concession in the province of Nampula and Portuguese-owned Portucel was granted 173,000 ha concession in Zambezia province.⁸ According to FIAN (2012) the Investment Facility Malonda Foundation (a Mozambican-SIDA co-operation) facilitated concessions for 550,000 ha in Niassa province for six companies that have set up forest plantations for timber (e.g. construction) and paper: Chikweti Forests of Niassa (since 2005: pine and eucalyptus), Florestas de Niassa, Companhia Florestal de Mas-sangulo, New Forests, Green Resources and, Florestas do Planalto. However, the planted area is so far only around 28,000 ha. Some of the forest concessions state they want to obtain a FSC certification (none do yet). These large forest plantations are all located in the center and north of the country. According to the forestry department of the Ministry of Agriculture, no significant forest plantations are planned for the South of the country. This is largely due to climate conditions and lack of available land for such developments. If a sustainable woodlot for charcoal production is to be established, it would be economically most viable to do so in the South of the country (closer to the major markets). Such a development may introduce commercial forest plantations to the south of the country. The benefits include job creation, a source of renewable biomass, as well as carbon capture if plantations occur on already deforested or marginal lands.

Forest plantations all have a tendency to plant eucalyptus and pine trees as these are fast growing species, have a diverse commercial value (i.e. can be used for construction as well as for paper and pulp) and there is expertise available. No plantation uses native species. In Brazil, eucalyptus is also used to produce charcoal for the steel industry. Eucalyptus and Pine seem not suitable for consumer-oriented charcoal production in Mozambique, as consumers strongly prefer other tree species (like Mopani). Maybe residues can be used for making cheap charcoal as prices rise although this would compete with the residues from current

⁸ <http://forestindustries.eu/content/mozambique-government-approves-eucalyptus-plantations>

charcoal-making processes (the small pieces that are now left in the area). The main complaints from local people about forest plantations are the loss of access to fertile land and that the plantation actually occupies more land than was allocated to the company under the DUAT. On the other hand these plantations also employ people (currently less than predicted and there are complaints about the working conditions). The current forest management practices for charcoal production are discussed in the next chapter.

3.4 Latest Biomass Energy policy developments

The Government of Mozambique has decided to design a national Biomass Energy Strategy (BEST) with the support of the European Union Energy Initiative (EUEI), focusing on the charcoal supply chain and addressing both the supply and the demand side. The Ministry of Energy, the National Directorate for New and Renewable Energy (DNRE), led the strategy development process. The BEST study was presented in 2012. A strong element of the study is that it shows the strong potential of charcoal as a renewable energy source and being an attractive commercial commodity if properly managed. This point was emphasized in the multi-stakeholder workshop in July 2011 at the start of the study. Complicating factor for effective implementation of a charcoal policy is that it touches various issues and thus the mandates of multiple Ministries: the Ministry of Energy (ME) as charcoal is used for energy purposes, Ministry of Agriculture MINAG with the Forest department (forest use license, DUAT), Ministry of Coordination of Environmental Action (MICOA: responsible for climate financing and CDM, EIAs etc.), Ministry of Finance (taxes), Ministry of Planning and Development, Ministry of Industry and Commerce and Ministry of Science and Technology (MST: innovative production methods). The 2012 BEST study describes the various institutional actors, their mandates and problems in order to solve co-ordination and to provide suggestions. The main suggestions are:

- Regulatory changes related to decentralization, new fiscal measures and re-allocating more revenues to communities;
- The institutional set-up of a independent Biomass Energy Agency (ANB);
- Formalizing and professionalizing the charcoal value chain;
- Community-based capacity building on natural resource management;
- Monitoring of charcoal flows and verification of compliance with taxes'
- Promotion of improved charcoal stoves;
- Promotion of modern biomass-based cooking fuels.

The government decided to conduct another internal process to formulate their biomass strategy. The new plan is expected at the end of 2013 / beginning of 2014 and has been send for approval to the Council of Ministers in December 2013. According to the Ministry of Energy, the new strategy for the conservation and sustainable usage of biomass energy has the following general objective: "To promote sustainable production and usage of biomass energy through the adoption of alternative energy sources, in this way contributing to energy security in the domestic and industrial sector"

The specific objectives of this new strategy include:

- To introduce energy alternatives as to substitute firewood and charcoal;
- To discourage the use of conventional biomass fuels as primary energy source;

- To reinforce the capacity of institutions in the control of the charcoal and firewood value chain (note: this objective could be supported by a NAMA).

The draft plan defines goals and intentions but does not set specific targets.

From an interview with the Ministry of Energy it became clear that the government realizes that the current informal set-up of the charcoal value chain is too complicated to regularize and restructure in order to avoid the negative effects of forest degradation and subsistence charcoal production. The GoM aims to regularize the sector with a greater role for the private sector to make the sector value chain more commercial and to get more grip on deforestation.

It should be noted that the draft policy document (currently submitted for final approval) does not include a component on climate financing. A brief section under environmental considerations does however mention the need to "mobilize funds and partnerships for the introduction of new conversion and combustion technologies with an objective to reduce green-house gas emissions".

3.5 Institutional setting relevant for the charcoal sector

The 2012 BEST study - and some other studies - provides a problem analysis related to the institutional setting in Mozambique. This chapter summarizes the information for several major government actors focusing on opportunities derived from the problem analysis (not reiterated here):

1. Ministry of Energy

The Ministry of Energy would benefit from including in its energy mix a renewable source of biomass energy (i.e. fuel wood, charcoal, pellets). This can be channelled through the department of new and renewable energies. The ministry has the capacity to develop policies aimed at regulating and modernizing the charcoal sector. Systems of efficiency standardizations and certifications can be developed by the ministry to promote sustainability in production.

This Ministry is currently developing a new biomass strategy and chairs the Inter-Ministerial Commission on Biofuels. In relation to the new biomass energy strategy also the institutional set-up for implementation was discussed. Initially the strategy proposed the creation of an institution comprised of technical staff from three ministries (ME, MINAG and MICOA). This idea was however not approved by the Ministry of Agriculture. The Ministries have now decided that the Inter-ministerial Commission on Biofuels will be restructured to also govern biomass energy. The commission will now be called *the Inter-ministerial Commission on Bioenergy* (CIB). The commission will be led by a group of Ministers and include technical staff from the various ministries. The Minister of Energy will be the President of the Commission (as it is now). The previous commission was rather effective in developing new policies to guide biofuel developments and investments in the country and has been developing a sustainability framework. The charcoal sector can profit from these co-ordination experiences and future experience with the new sustainability framework.

2. Ministry of Agriculture

It is currently the Ministry of Agriculture, which regulates charcoal production by issuing exploitation licenses and monitoring transport routes to ensure the marketed charcoal is licensed. The capacity to control for forest management practices and sustainable production is currently limited. By increasing the capacity of the ministry and its field staff to monitor production sites will in turn promote better production practices.

Another approach is to engage with local communities and create conditions for them to be the owners of the surrounding forest resources. The ownership of limited forest areas will incentivise for charcoal producers within these communities to manage their forest resources more effectively.

3. Ministry of Finance

The charcoal sector is estimated to generate up to 400 Million US Dollars annually, which corresponds to 2.2% of the country's GNI (2012). The BEST country analysis (BEST, 2012), estimated only 5% of the current charcoal sector to be formal. Or in other words, the treasury loses millions of dollars in possible tax income due to the informal nature of the industry. Promoting a more structured and regulated charcoal production approach will generate additional revenue for the state. This revenue in turn could be channelled for forest management and reforestation programmes.

4. Ministry of Environment

The current charcoal sector is responsible for significant levels of deforestation and Greenhouse Gas emissions. This Ministry is responsible for climate change and for creating favourable framework conditions for climate financing (CDM, NAMA, REDD and other carbon financing options).

5. The Ministry of Industry and Commerce

As mentioned before, the charcoal sector has a large economic potential, which is currently channelled within informal means. Sustainable and regulated charcoal production can have immense benefits for regional economics. The Ministry of Industry and Commerce is able to provide support by elaborating a road map to develop a modern charcoal sector. The ministry can also promote for a more equitable revenue sharing system along the entire charcoal value chain. If charcoal production becomes a formal activity, wage standards and price standardizations could foster higher revenue for employees along the value chain (loggers, kiln builders, bag sorters). The bulk of the margins currently lie in the transportation and commercialization levels (see chapter 4). The charcoal producers usually profit the least from this activity – and are those who could use more funds to apply forest management practices in the forests where they work.

6. Ministry of Science and Technology

The Ministry of Science and Technology can have an important role in the promotion and dissemination of improved carbonization technologies (improved kilns) as well as improved stoves. Furthermore, the ministry can contribute towards the establishment of testing centres and testing standards for these improved kilns and stoves.

7. FUNAE

FUNAE (Fundo Nacional de Energia) is a public entity that facilitates funding and invests in renewable energy in off-grid rural areas. It is an implementing agency rather than a policy-making institute but it informs policy-making through studies and project evaluations. More and more it provides technical and financial assistance to enterprises that have the objective to produce and disseminate electricity. FUNAE also has a Biomass Energy Department and promotes the efficient use of biomass (modern kilns, efficient stoves, promotes the use of agricultural residues for energy purposes and promotes the development and planting of forests for biomass purposes. In 2009, the GIZ PROBEC⁹ program was transferred to FUNAE and since then they have been involved in introducing efficient cook stoves in schools, hospitals and households. They have co-operated with Eduardo Mondlane University on training local producers in using modern (Casamance) kilns. FUNAE is considering a cook stoves project under the GIZ EnDev program¹⁰.

Formal employment is a big necessity in Mozambique. Whereas all Ministries are aware of this and support formal employment, the Ministry of Labour is responsible for this agenda and for example co-operates with the ILO on a decent work agenda.

⁹ Program for Basic Energy and Conservation in Southern Africa.

¹⁰ The German GIZ (Gesellschaft für Internationale Zusammenarbeit) implements the Energy for Development program, a partnership program financed by The Netherlands Development Co-operation.

4 The charcoal value chain in Mozambique

4.1 Charcoal value chain versus the firewood market

Throughout Mozambique firewood is used for energy purposes, either directly by households in rural areas or indirectly through charcoal produced from firewood. Firewood is also used at industrial and institutional level. Schools, hospitals, prisons, bakeries, restaurants and other establishments make use of biomass fuels on a daily basis. Industrial processes known to use biomass as energy source in Mozambique include: tea drying; tobacco drying; fish smoking; ceramics; brick making; and blacksmiths. There are no reliable figures on how much is used.

Both markets are interlinked, and many times originate from the same source. Depending on the demand, charcoal producers may also stock firewood for sale. The bakeries, prisons and hospitals in the urban areas are a major market for this firewood. With regards to the household market, charcoal is largely preferred. It is assumed that the household market is also the larger of the two, with 80-85% of households making use of this fuel for cooking every day.

The price for firewood varies according to sales point (and is for free for those collecting it themselves). At the supplier level, the price for firewood at wholesale is 1.5 Mt (meticaïs) per kg. At the retail level, the wholesale price for firewood is 2.5 Mt per kg (GreenLight field research, 2013). Charcoal on the other hand is sold at production point for 3.6 Meticaïs per Kg (250 Mt for a 70kg bag) or 1.6x times firewood. This is currently the standardized price amongst producers in Combomune and Mabalane districts. Within the markets of Maputo city, this same charcoal is sold at a market price of 12 Meticaïs per Kg when in the form of a 70 kg charcoal sack (total 840 Mt). At retail charcoal is 3.3 times more expensive than firewood.

Table 2: Firewood prices at Gaza Province sales points

Quantity firewood	Supplier price (Mt)		Retail price (Mt)	
	Price at wholesale	Price at market point	Price at wholesale	Price at market place
1 Pile (10 Kg)	15,00	20,00	25,00	35,00
1 Stack (200 Kg)	300,00	400,00	500,00	700,00
1 small truck load (2,000 Kg)	3.000,00	4.000,00	5.000,00	7.000,00

Table 3: Charcoal prices in Gaza province production point and Maputo city retail point

Quantity charcoal	Supplier price (Mt)	Retail price (Mt)
	At supply point (Gaza)	Price at Maputo market
1 pile (500 g)	--	12,00
1 Sack (70 kg)	250,00	850,00

The market value for charcoal is therefore a lucrative option for producers and retailers altogether. The charcoal value chain tends to be more extensive compared to that of firewood. Whereas for firewood, it is normally the customers which organize the delivery of larger quantities of firewood at one time (such as for schools, prisons, hospitals and bakeries);

the charcoal chain includes the producers, transporters, wholesalers, retailers and the final consumer.

The production of charcoal is associated with a greater environmental impact than firewood, especially near urban areas and is considered one of the main causes of deforestation in Africa (Cuvilas et al, 2010). This is because charcoal is produced mainly from the stems and large branches, and requires tree cutting (Girard, 2002).

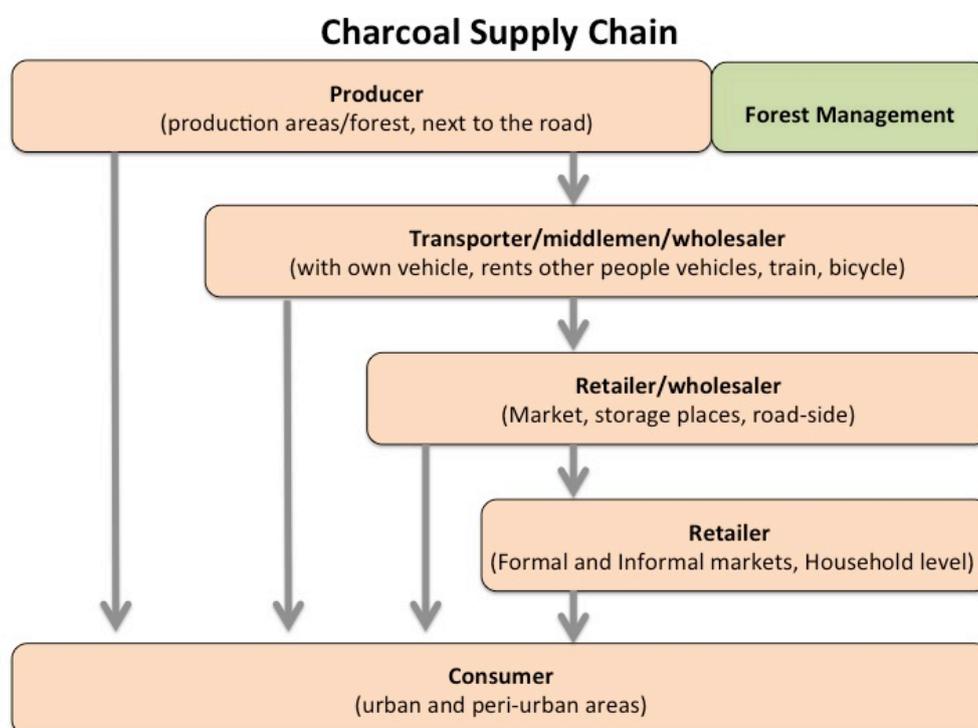
The charcoal sector – though largely informal - has more characteristics of a value chain and is better organized. This makes it also more feasible for interventions with climate financing (the subject of this report). This report therefore focuses on the sustainable production of charcoal, not firewood.

4.2 The Charcoal Value Chain

The charcoal value chain is comprised of five components:

1. Forest management
2. Production
3. Transport (transporter, middlemen, wholesaler)
4. Retail (wholesaler and retailer)
5. Consumption (households: mainly urban and peri-urban)

Figure 2: the charcoal supply chain.



Various parts of this value chain were researched, including interviews with stakeholders, during this study as well in a previous study by Atanassov in 2012 (Mozambique Urban Biomass

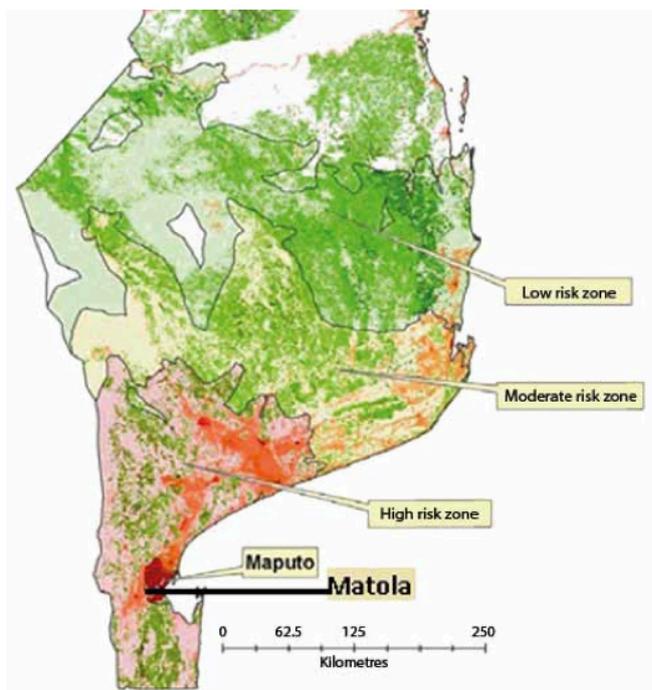
Energy Analysis). There are 5 key categories of major stakeholders that have been contacted, visited and interviewed (see annex for list), namely:

1. Central Government
2. Provincial and Local Governments
3. Transporter/Middleman/Wholesaler/Retailer
4. Charcoal harvesting/producing communities
5. Companies with a potential interest in charcoal

4.2.1 Forest Management

Forest management is often not included in a charcoal value chain diagram because there has been limited experience with managed woodlots for the production of charcoal. But it forms a crucial element of supply chain and without proper attention to forest management no sustainable supply chain is possible (as degradation already occurs). In 2010, the natural forest cover of Mozambique was estimated at 39 million hectares (i.e. 50% forest cover) with a deforestation rate of 219,000 ha/year (FAO, 2010). Other wooded land was estimated at 14.6 million ha with a deforestation rate of 29,000 ha/yr. Miombo woodland is the most extensive vegetation type and dominant in the North and Centre of the country. Most forests (67%) are classified as production forests, i.e. are not protected. Fire wood and charcoal was produced from about 30.6 million hectares of forests (Ministério da Energia, 2009; BEST 2012).

Figure 3: Risk of forest degradation as a result of charcoal production.



Source: Cuambe (2009).

In 2008, a study called WISDOM (Woodfuels Integrated Supply-Demand Overview Mapping) was carried out to assess the supply and demand balance of Mozambique's forest biomass

and enhance the capacity of the country in the formulation of sound wood energy and forest policies (GoM 2008, Ministry of Agriculture-DNTF, supported by Italy). The total non-industrial productivity of woody biomass annually available for the entire country is estimated at 62 million tonnes (t * 10⁶, air dry, 12% moisture) from which some 46.9 million tonnes are physically accessible and potentially available for energy use. The total consumption in the residential and commercial sector was estimated at 14 million tonnes. In theory, at national level there is a surplus. In reality however, deforestation pressures and re-growth figures vary leading to degraded areas.

Forest degradation is a major issue for the country as a result of logging of the most valuable tree species, conversion for agricultural production, shifting cultivation and forest fires, and charcoal production (CIFOR 2012). Various studies indicate a strong relationship between fuel wood production and deforestation and forest degradation (Pereira et al. 2001, Argola 2004, Marzoli 2007). Most forested lands, especially the woodlands close to cities and villages, are severely degraded (due to overharvesting of fuel wood and charcoal production). The European Space Agency (ESA) states that 42% is to some extent degraded and 19% of land shows on-going degradation¹¹. In various parts of the country the destruction of the vegetation cover has led to topsoil erosion (loss of soil fertility) and desertification. In turn this negatively affects the water storage capacity of soils and the recharge of aquifers.

Although, proper legislation exists, there are yet no successful examples in Mozambique with sustainable forest management. In general, charcoal producers -especially those with no individual or communal ownership - do not show concern for forest management procedures. However, from the field study it became evident that the two visited CPAs - with members having a license for a specific exploitation block - are concerned at the sustainability of their wood supply and forest management practices. Whether the other CPAs are organised in a similar way has to be determined during the feasibility assessment in the next phase of this initiative.

Box 2 : Miombo woodland and the Mopani tree (Wessels D, 2005).

The main charcoal production areas in Mozambique are Miombo woodlands.

The field research showed that in Gaza province mainly the Mopani tree is used for charcoal production as it is preferred by consumers. The Mopani tree (*Colophospermum mopane*) is a deciduous, slow growing species with leathery leaves and an erect narrow crown and one of the dominant trees in the Miombo woodland. It can grow in a rainfall zone of 400-700mm with a long dry season and an altitudinal range of 300 – 1,000m (Timberlake, 1995). *C. mopane* drops its leaves in an irregular fashion from the onset of the dry season and is generally leafless in August to October. The ripe fruits appear from March to June and seeds are dispersed by rainwash and wind (maximum 8m from the parent tree or 1.6x the tree height). Although one tree produces many seeds, mortality rates are high and the regeneration requirements are yet largely unknown. Under the right soil conditions, trees can reach 20m.

¹¹ <http://due.esrin.esa.int/newsImage.php?dbid=2041>

More common the ranges around 10m or as shrub of 1-2m in unfavourable circumstances. In very dense Mopane dominated woodland in northern South Africa 2,289 trees / ha were found (Cunningham, 1996). Typical tree density is around 200-400 trees / ha (Timberlake, 1995).

Picture 1: Pile of cut Mopani trees for charcoal production, Gaza Province 2013.



Despite this body of information there appears to be no published information on stand establishment or mortality. Given the economic importance of this multi-purpose woodland, surprisingly little basic ecological information is available on which to base management prescriptions. If one uses the average figures of the field research combined with literature (see box) on the Mopani tree the following size of a sustainable production block is calculated

Some characteristics related to forest management:

- Producers need to have DUAT land rights and a forest exploitation license. They pay for the actual production per charcoal bag (see next paragraph).
- The forest is divided into individual exploitation blocks. The average size is unknown.
- The Mopani trees are cut at 25-30 cm diameter and the stem is left for natural re-growth.
- In Gaza province the producers state that re-growth to a production-size tree takes about 20 years. Literature suggests an average diameter growth rate of Mopani at 590 mm per year. That would suggest size-able trees at 4-5 years. See also box 2. The difference is not researched but may be related to the availability of water and nutrients. This needs further attention before the size of a 'sustainable exploitation blocks' is determined.
- A producer may legally produce 70,000 kg charcoal for which he/she would need 490,000 kg of wood considering an average kiln efficiency of 7 : 1 (field work result).

- Cunningham (1996) estimated the wooden biomass available for charcoal production at 14,787 kg/ha for Mopani woodland. He used a harvesting rate of 25%, which means the available biomass for sustainable production is 3,697 kg/ha.
- This means a legal, sustainable Exploitation Block could be 132 -166 ha assuming the re-growth takes 4-5 years. Of course the size increases if the re-growth takes longer than 5 years. According to local producers they would need 150-200 ha (field study interviews).
- Firstly, with a more efficient kiln production can be significantly improved or the size of the Exploitation block could be reduced (depending on the availability of suitable forest).
- Secondly, in this calculation only Mopani trees are used and no other Miombo woodland trees or shrubs are added.

Compared to the forest plantations (average 90,000 ha per concession) described in paragraph 3.3 the needed surface area per producer is not so big. A Charcoal Producer Association may however consist of 1,000 or more producers and therefore one Association would need to manage 130,000 – 165,000 ha (1,300 – 1,650 km²). Whether this amount of land is actually available to a community has to be determined per target region and community. Or the number of producers per CPA has to be reduced.

4.2.2 Producers and charcoal production

The charcoal producers can be sub-divided into two categories:

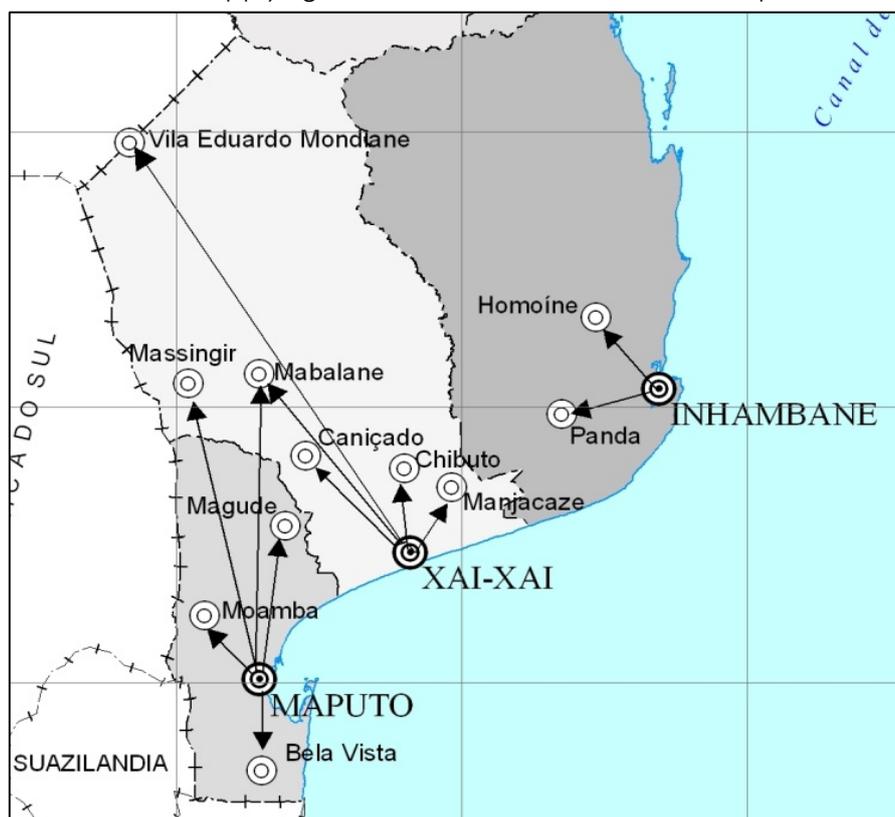
1. The formal charcoal production license holders who in turn employ people who receive a monthly payment for production;
2. Those who produce informally on their own account and sell their bags 'at the gate'.

Charcoal producers are either individuals or form associations from the communities that reside near the forested areas. A Charcoal Producer Association (CPA) is thus a combination of administrative and geographic boundaries. Others (employees) come from other regions to partake in this activity.

Although charcoal production can be scattered throughout the rural areas, there are certain regions where production is more concentrated. It is from these regions that the bulk of the charcoal supplying Maputo city originates. Consumers show a preference for charcoal originating from certain regions, as they associate it with a "good quality product". These regions usually contain hard-wood forested areas (like Mopani) from which charcoal is produced.

Within the Province of Maputo, known charcoal production regions include Moamba, Matutuine, Namaacha, Goba, Boane and Manhiça. These regions however have suffered from over-exploitation of forest resources over the past several years. The majority of charcoal that feeds Maputo urban markets is currently coming from further locations (>300km) such as Magude district in Maputo province, but mainly from regions in Gaza Province (visited during this study), such as the districts of Mabalane, Massingir, Mapai, Chicualacuala, and Guijá (Atanassov et al 2012. See also figures 3 and 4).

Figure 4: Production areas supplying urban areas in Southern Mozambique.



Source: Ministry of Agriculture – Department of Forestry (2012)

In a recent field visit to two charcoal production communities in Gaza province, namely: Mabalane and Combomune, a common trend was noticed. As a means to protect the forest resources within the region, and assure equitable exploration of these, the charcoal producers from these communities have formed an association of charcoal producers. Within both districts, these associations were comprised of close to 1000 members each. It is not clear how active each member is or everyone has a license. This has to be investigated in the next phase for all 7 associations. Within an association, a further subdivision of interest groups of up to 100 members was common.

The members of the association show a good level of organization: they discuss and agree upon fixed prices for charcoal sale; employment terms and conditions; forest exploration areas and legal structures; and conduct some monitoring. Although no formal plan for forest management and sustainable production currently exists within these associations, it is feasible that through an organized Charcoal Producer Organization (CPAs) such an activity can be realized. The interviews and field visit suggest that there are 7 CPAs that are organized and function well (with a board) and several others which are not so well organized. Exact figures could not be obtained. If and how the CPAs can be turned into well-functioning entities needs further study.

Some characteristics of organized charcoal production (see also par. 4.3):

- An individual producer has to have a license (5 Mt per 70 kg bag) and can be organised in a Charcoal Producer Association, which grants the producer the right to an Exploitation Block.
- The producer works year round but the production decreases in the rainy season (January – April) with 20-30%.
- A producer may legally produce a maximum of 1,000 bags per year under his/her license.
- The production capacity of an earth kiln ranges between 30 to 65 bags (70 kg) of charcoal (which takes 1 month between construction of the kiln and final product) – depending on the amount of wood used and whether this is green wood or dried wood), and the construction of the kiln. The average is 40 bags (= 2,800 kg charcoal).
- The average kiln efficiency is 14%: 7 kg of wood produces 1 kg of charcoal
- An exploitation block has 6 to 8 kilns
- For the legal amount of 1,000 bags the producer thus needs to produce 70,000 kg charcoal.
- Two persons operate each kiln. An organised producer hires people to operate the kiln so each exploitation block employs 12 to 16 people.
- Expenses include mainly the license, a chainsaw, employees, transport and food.
- At the production site the price of a 70 kg bag is 250 Mt. The profit is shared between producer (100 Mt) and workers (2x 50 Mt).

As stated before (par. 3.2), the charcoal sector continues to be largely informal. Current license holders are often linked to producers associations (e.g. Mabalane area, Mahel and Massingir). Some expert estimates only 10% of the charcoal produced is licensed (Siteo *et al.* 2008, Falcão *et al.* 2012). According to the BEST country analysis (BEST, 2012), only 5% of the current charcoal sector is thought to be formal.

Charcoal in Mozambique is produced by using traditional *earth kilns*. Studies on charcoal production found the kiln efficiency to be 10-20% with an average of 14%: a conversion ratio of 7 kg of wood for the production of 1 kg charcoal. More efficient methods are available for charcoal production. An improved earth kiln would for example include a chimney to control the carbonization process. Other designs, like a retort kiln, can double production but few producers have received training in the use of improved kilns. FUNAE and the University of Eduardo Mondlane carried out a series of trainings throughout the country on improved kiln construction. In a subsequent monitoring exercise, it was noticed that none of the trainees continued using the improved kilns (Casamance). Allegedly, because the introduced technology is more time consuming (wood has to be cut in smaller pieces, the process takes longer) and does not allow for larger quantities of wood to be carbonized at one time (lack of wood is often not issue for them as they shift location of the earth kilns). More technologically advanced kilns such as the Mark IV, Cusab Kiln, and Gayland Batch Charcoal Retort give higher efficiency rates of 25–32% (Cunningham, 1996; Lew and Kammen, 1997; Okello *et al.*, 2001). These kilns could significantly improve charcoal production in the rural areas. However, some of these kilns have been tested in the South of Mozambique and the results showed that they are usually out of the financial reach of most charcoal burners and they require more labor. This means they are unlikely to be

implemented by many charcoal producers. (Falcao et al. 2012). Isac Tsamba of the Biomass Energy Department of FUNAE believes that another type of improved kiln should be introduced of which the producers are convinced of its efficiency and its ease of use.

In the light of potential climate financing, there is no experience with methane abatement or flaring at the kilns.

Picture 2.: Fire wood stacked in an earth kiln.



Picture 3: Traditional earth kiln in Mozambique.



4.2.3 Transport

Due to the large distances from charcoal production sites to retail points in the cities, transport is a crucial step within the value chain, not only to reach a market but also in financial terms. The majority of charcoal is transported by large trucks (varying between 8 and 16 tonnes. See picture below). For production sites in proximity to railway stations, it is not uncommon for charcoal to be transported by train to the cities. This however requires further

logistics and labor to transport the charcoal from production site to train station, load it on train, and from end terminal to the markets.

Picture 4.: Transport of charcoal by truck from Gaza province, 2013.



According to an official from the Ministry of Agriculture stationed in Combomune, "Charcoal is transported to Maputo either by rail or by truck. Mostly it is transported by truck. The trucks are either owned by the charcoal producers themselves, or in most of the cases, hired by wholesalers in the city to transport the charcoal to the urban markets. Something like 15 trucks pass these roads every day full of charcoal." With this description in mind, it can be estimated that 160 tonnes of charcoal comes in daily to Maputo only via road from the Gaza charcoal production regions. The truck driver charges 200 Mt (7 US\$) per 70 kg charcoal bag. The drivers can make between 22,800-45,700 Mt per trip (depending on his truck) with an average of 30,000 Mt (1000 USD) per trip. According to Gilberto Mahumane (2012), it is the transporter that makes the most money within the charcoal value chain.¹²

In some cases, the charcoal producers may own a truck themselves. In this instance, the revenues of the producers increase exponentially, as profit margins become larger. One such charcoal producer was met during the recent field visit to Mabalane community. Dona Rosa has organized her business so that she manages the entire value chain. She hires workers to produce the charcoal on her allocated forest lots; she transports the charcoal to Maputo city with her own 10 tonne truck and retails the charcoal from a whole-sale yard where she employs a sales person.

The local official from Combomune community further explained the licensing system, which impacts mostly the transporters: "Those purchasing the charcoal sacks also need to obtain a license for this act. Normally it is the transporter of the charcoal, which holds this license. The

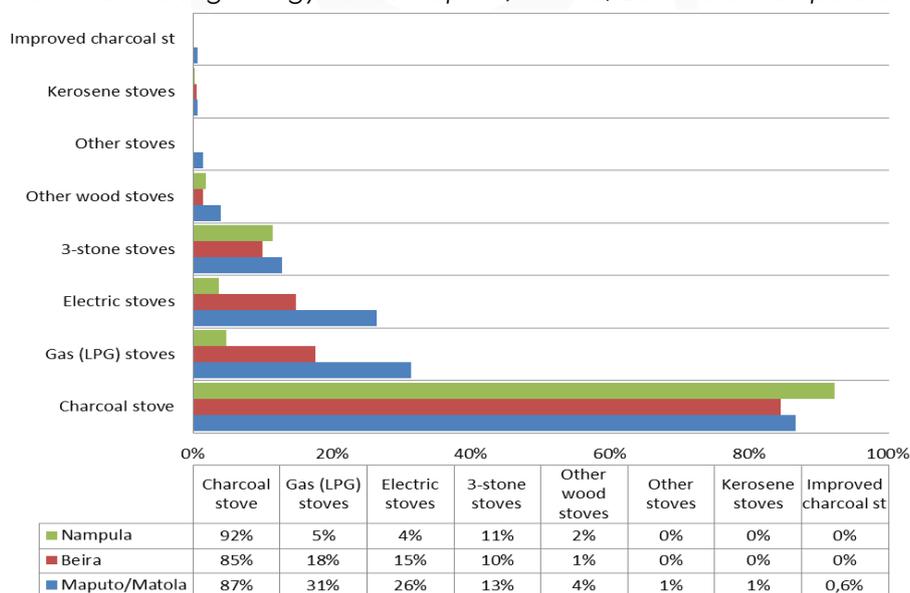
¹² It is however not clear how margins are calculated. It appears to be based on running costs and it did not take into account the investment costs of buying the truck, appreciation and maintenance.

standard fee is 75 Meticaís per sack for the commercialization license, and 5 Meticaís per sack for the production license. The local agricultural department has fiscal staff, which requires the truck drivers to show a license for the amount of charcoal sacks carried. If the transporter carries more sacks than the license permits or does not have a license, than a penalty (fine) is paid. This penalty is 20 000 Meticaís (667 USD)“.

4.2.4 Retail and Consumption

The charcoal sector in Mozambique is substantial, characterized by a large (80%) and rising consumption of charcoal in volume by urban people (the share of charcoal actually goes down but the urban population is growing fast). All rural people use fuel wood for cooking. In addition, over \$200 million worth of charcoal is sold in the towns and cities (also primarily for cooking).¹³ The capital Maputo is the main market with the highest prices. The average charcoal use of a typical Maputo household was found to be 70-75kg per month. Charcoal is the most accessible cooking fuel in the urban areas. Within the markets of Maputo city, charcoal is sold at a market price of 12 Meticaís per Kg when in the form of a 70 kg charcoal sack (total 840 Mt). At retail charcoal is 3.3 times more expensive than firewood. Those purchasing in daily quantities will pay double this amount at 24 Mt per kg (12 Mt per ‘pile’ of 500g). While other modern fuels such as LPG and ethanol are sold only from official retail points (not always close to the customers), charcoal is even sold at neighborhood level by resident retailers.

Figure 5: Household cooking energy use in Maputo/Matola, Beira and Nampula cities.



Source: Atanassov et al. (2012).

The table below shows charcoal prices that have been compiled based on survey information collected at charcoal markets in Maputo city by GreenLight researchers over the past 7 years. The stated prices are the annual averages based on price indexes from the

¹³ BEST Mozambique Study and Ministry of Energy (2009), *Estratégia de Energia*.

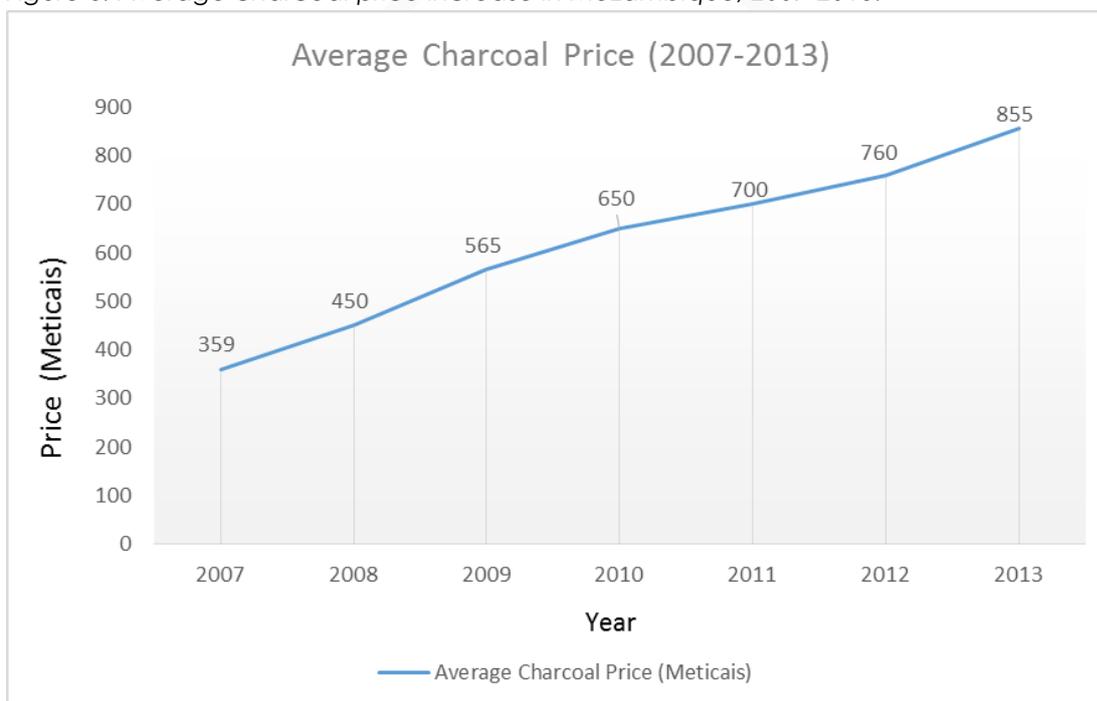
various points in the cities. The prices correspond to the conventional 70 kg sacks of charcoal sold by wholesalers and retailers across the city.

Table 4: Charcoal prices

Year	Average Charcoal Price (Meticais)	Percentage increase from previous year
2007	359	--
2008	450	25%
2009	565	25.5%
2010	650	15%
2011	700	7.7%
2012	760	8.6%
2013	840 - 855	12.5%

The results show an average of 15.7% increase in the charcoal price every year. If the year 2007 is considered a baseline, then the charcoal price in 2013 has increased by 138.2%. This is more than double in the span of 6 years.

Figure 6: Average charcoal price increase in Mozambique, 2007-2013.



Source: Atanassov et al. 2012.

4.3 The Economics in the Charcoal Value Chain and pricing

In order to assess the viability of UNFCCC financed activity (like a CDM Programme of Activities. See chapter 5) within a sustainable charcoal production model, a cost benefit analysis must be made. A breakdown of the cost structure in the currently dominating informal charcoal business will be necessary for comparing the costs associated with a

sustainably managed production of the commodity. An overview of the economics in the charcoal value chain is provided in the table on the next page.

Conclusion

The next phase entails the feasibility study of climate financing. In the current phase two CPAs have been visited as a case study. That does not mean that sufficient information is yet available about all potential CPAs and their level of organisation to assess whether they can be eligible or feasible partners.

Secondly, the producers interviewed are very aware of the forest degradation in their Exploitation Block and are very worried about illegal logging in their block. If the exploitation blocks have a sufficient size (for rotation) than Sustainable Forest Management (SFM) is a feasible option. Whether this is the same for the other CPAs has to be assessed during the feasibility study.

SFM will not negatively push up the price of sustainably produced charcoal as producers are already limited to 1,000 bags of charcoal per year. Also the number of producers will be limited through the CPAs as they have a limited amount of land available. On the contrary, the combination of kiln efficiency and SFM will make the sustainable charcoal competitive in price with ordinary charcoal.

Also an analysis of the GHG emissions generated during traditional charcoal production will have to be made to determine the savings achieved with increased production efficiency and methane abatement. In theory, there is already much to be gained in terms of emission reductions by only improving the efficiency of kilns (30-40% is feasible in stead of the current average 14%).

Table 5: Economics of the Charcoal Value Chain in Mozambique.

Charcoal Value Chain statistics	Economics	Total
Consumer		
Average income 5500 Mt / month	Price: 840 Mt / 70 kg bag	15% of average monthly income
Poor urban households 3500 Mt / month		24% of average monthly income of poor HH
Average consumption one 70kg bag / month		
Wholesaler		
Expenses: 5 meticaís per day license to sell at market	Price: 840 Mt / 70 kg bag	Turnover retailer: 9,150 Mt / month
Expenses: buying charcoal at 520 Mt / bag	Revenue: 320 Mt / 70 kg bag	
Expenses: 10 Mt per day to pay collective guard at market		
Sale: average of 30 bags per month		
Transporter		
Expenses: logistics costs at 60 Mt / bag (when carrying 125 bags)	Price: 200 Mt / 70 kg bag	Turnover transporter: 26,250 Mt / month
Expenses: Charcoal transportation license at 70 Mt / bag	Revenue: 70 Mt / 70 kg bag	
Transportation fee: 200 Mt / bag	Revenue on truck load: 8750 Mt	
Load per truck 100-150 bags		
On average 3 trips per month		
Production charcoal		
Expenses: Land use license is community owned	Price: 250 Mt / 70 kg bag	Turnover per block: 60,000 Mt / month
Expenses: Individual Producer license 5 Mt / bag	kiln efficiency 16%	Producer: 24,000 Mt/month
Expenses: logging with chainsaw = 1,200 Mt per chainsaw	Average: 40 bags / kiln	Workers: 24,000 Mt / 12 workers / month
Expenses: food 2,575 MT/month per 2 workers = 1 kiln		Worker: 2,000 Mt/month
6-8 kilns per month in 1 exploitation block	Average: 6 kilns per block	
7 kg of wood for 1 kg charcoal	Producer: 4,000 Mt/kiln	
2 people per kiln = 12 -16 employed	Worker: 2,000 Mt/kiln	
One kiln produces 30-65 bags of charcoal = max 520 bags/block/month		
Producer and worker divide sale of bag: 100 Mt producer, 50Mt per worker		
<i>Producer may only produce 1,000 bags per year</i>		<i>Maximum leads to 250,000 Mt per year</i>
Forest area		
Charcoal production on community forest land (Mopani trees)	max. 560 trees/block for 8 kilns	Legal, sustainable block size: 132 - 166 ha
Producers must organize into Charcoal Producer Associations		According to locals 150-200 ha per license
Forest area divided into exploitation blocks. Hectares unknown.		
One kiln: App. 70 Mopani trees of 25 cm diameter = app. 21 tonnes wood		
Average diameter growth rate Mopani is 590 mm/yr		
Mopani trees are cut at app 4-5 years		
Typically tree density per hectare 200-400 trees		
Trees are cut at 25-30 cm for regeneration		

5 Climate financing options: CDM PoA and NAMA

In general, significant emission reductions can be achieved by introducing improved kilns and forest management principles and these emission reductions can be eligible for carbon market financing. Implementing a project in the charcoal sector of Mozambique with UNFCCC related climate financing faces several serious obstacles however, which are described further. Establishing a feasible and adequate Project – with measurable, reportable and verifiable (MRV) results for the charcoal sector would ideally entail the following steps (UNDP, 2013):

- *Assessment*: Knowing the scale of the problem in order to provide a solution at a sufficient or at least meaningful scale.
- *Analysis*: Presenting the value chain that links the consumption of charcoal as cooking energy to deforestation.
- *Formulation of response*: On the basis of the value chain, identifying and selecting the most appropriate scope of intervention to address the problem (e.g. deployment of improved production technologies; switch to alternative sources)
- *Defining verifiable outputs (first part of the MRV)*: Defining, calculating and monitoring the results achieved by the activities.
- *Evaluation of cost-effectiveness (second part of the MRV)*: Economic indicators on the cost effectiveness of the problem should be included in order to check the cost of avoided emissions against initial assumptions. In the case of a NAMA other sustainable development benefits will be important progress indicators.
- *Evaluation of the impacts (third part of MRV)*: The MRV of the results should enable an evaluation of the impacts.

The current study presents the first steps including Assessment, Analysis, and Formulation of a potential response.

The second phase is the feasibility assessment, which includes the selection of promising responses by the government of Mozambique and the stakeholders in the value chain and an in-depth study with value chain partners what would be tangible and verifiable outputs as well as an evaluation of the cost-effectiveness. In theory the following climate financing options exist:

1. Clean Development Mechanism Program of Activities (CDM PoA): par. 5.1
2. Nationally Appropriate Mitigation Action (NAMA): par 5.2
3. Reduced Emissions from Deforestation and forest Degradation (REDD): par. 5.3
4. Voluntary carbon credits: par. 5.4

However, we feel the measures identified should be feasible and adequate from a sustainable development perspective (economic, social and ecological) first and from the financing perspective second. This will make it possible to identify promising actions regardless from what source financing will become available to tackle obstacles.

5.1 Option Clean Development Mechanism Programme of Activities (CDM PoA)

Under the CDM a facility has been developed called PoA (Program of Activities), which aims to bundle a large amount of small emission-reduction activities with the purpose to create such a scale that the activity can earn carbon credits in a cost-effective way. Implementing any project with climate financing in the charcoal sector of Mozambique faces several serious obstacles:

- Financing has to come from the formal purchase of carbon credits, meaning the counterparts have to be legalised and operational entities.
- The charcoal sector is not well organized. It is mostly informal and producers have no formal license. To purchase formal credits is difficult, as it requires monitoring and reporting. A project can therefore only link to established Charcoal Producer Association or to a company.
- Producers might not be willing to adopt advanced charcoal production facilities and/or subject themselves to strict monitoring protocols, if there is no clear monetary benefit to them.
- Current carbon credit prices are low and uncertain, so any activity has to be commercially viable in 3-5 years whereby climate financing is used to tackle obstacles and make sustainable production competitive.

The legal backing of licenses is needed to create a formal CDM structure and because commercial production of charcoal would have to compete with the informal market which relies on minimum up-front costs (this could for example be the focus of a NAMA). The mostly informal nature of the sector is a serious obstacle for any activity.

The literature and field research (September 2013) show that:

- Charcoal Producer Associations exist around Maputo who are sufficiently organized to pilot activities. Some additional capacity support is needed to make them fully eligible for climate financing and probably an umbrella entity is needed as recipient of foreign financing and to distribute financing in a competitive manner to Associations that want to become a partner;
- Producers in CPAs show interest in co-operating on making the production more sustainable. They understand the pros and cons, have their own ideas and voice them, and show a clear understanding of marketing and entrepreneurship;
- Producers express they are individual entrepreneurs that have the responsibility for one Exploitation Block. Producers seem willing to establish a highly efficient fixed kiln with some movable earth kilns. They want individual responsibility and accountability and show a willingness to invest themselves, meaning that within one Association, some individuals will become successful, others will not. This has to be checked at the workshop and with all members of a CPA.

Under the CDM only few UNFCCC registered methodologies concern the charcoal sector and there is little experience yet:

- AMS-III.BG: Emission reduction through sustainable charcoal production and consumption. One project registered at UNFCCC.
- AMS-III.K: Avoidance of methane release from charcoal production. No projects.

- ACM0021: Reduction of emissions from charcoal production by improved kiln design and/or abatement of methane. No projects registered (but under former methodology AM0041 four projects are registered).

As far as can be determined, none of the registered projects have so far issued CERs.

General findings and lessons learned suggest that sustainable forest management should be part of any charcoal related action in order to become viable and sustainable on the long-term with tangible benefits for local producers (GIZ, 2010).

AMS-III.BG: The methodology requires inclusion of identified consumer households in the project boundary (through sales records or long-term sales contracts) and is limited to renewable biomass feedstock and in practice, in case of a PoA, limited to biomass residues. The literature, field research and interviews indicate inclusion of consumer households in a project will be difficult as there is no direct organized link between producers and consumers (which are not organized and buy charcoal from different regions). The role of the consumers is closely linked to introducing and using improved charcoal cook stoves (or alternative energy sources). Projects have often failed as consumers are conservative and price-driven. But with the high price of charcoal the last couple of years, alternatives have become attractive and people are using them. In addition, there are various ongoing projects in Mozambique providing improved charcoal cook stoves [like by SNV Mozambique and GIZ]. To co-ordinate these efforts with climate-financed sector activities an umbrella entity should be made responsible.

For the first time, for Uganda a *Standardized Baseline (SB)* has been registered to be used in conjunction with AMS-III-BG. This SB defines certain default values for emissions from charcoal production for Uganda, to be used in this methodology as well as automatic additionality of Component Project Activities in a PoA when applying specified technologies (like Casamance Kilns). This approach could be followed if a Standardized Baseline is registered for the Mozambique case (on the basis of any approved methodology).

AMS-III.K: The methodology does only require methane destruction with or without improved kilns in a facility equipped with recovery and flaring/combustion. There is no experience in Mozambique with methane destruction and capacity of the producers is not high. Another difficulty in this methodology is the monitoring of input raw materials instead of output of charcoal. It seems feasible to train producers to monitor input as required but still much can be gained to have them use dried wood instead of wet green wood (theft of the drying wood may be a major issue!). Methane flaring does not seem a feasible methodology in the coming years.

ACM0021: The methodology focuses on the production of charcoal through improved kiln design as well as abatement of methane. The main conditions of the methodology are:

- ✓ The project shall not result in any changes in the type and source of input (i.e. wood source) for the production of charcoal. Producers use Mopani and will continue to do so.
- ✓ The project is implemented by charcoal producers that supply charcoal to a market.

Mozambique has Charcoal producer Associations that supply the consumer market.

- ✓ There are no regulations that prevent venting of methane gas generated from charcoal production. In Mozambique there is no legislation on methane flaring in the charcoal sector.
- ✓ Emission reductions are achieved through the adoption of technologies and processes for improved kiln design and operations, thereby replacing the existing kilns by newer design, that avoid or diminish the production of methane emissions in the carbonization process. Earth kilns can (and producers seem willing under certain conditions) be improved and/or replaced by improved kilns on a fixed location.
- ✓ Only kilns for which a gravimetric yield relation was derived are used in the baseline and/or project situation. This can be organised but needs baseline measurements and coordination.
- ✓ All the existing kilns to be improved or replaced by new (Greenfield) kilns by the project activity shall have the same mechanical design (specifications in the methodology). This should not be a major problem.

More difficult conditions are:

- All the kilns in the project boundary are operated in batch mode and each carbonization cycle can be clearly distinguished with its start time and end time marked by the ignition of the kiln and the seal of the kiln. The kilns of a Charcoal Producer Associations can be considered a batch but are yet not organised as a batch: every producer has its own earth kiln and ignites it at his/her own schedule. New fixed kilns (one per Exploitation Block) could be organised as a batch.
- For projects that consider increase in the existing rated capacity of carbonization or for Greenfield projects, the renewable raw material supplies used in the project activity should originate from sustainable sources of biomass. The producers have stated that they are interested in sustainable forest management for their exploitation block. In order to establish a sustainable rotation the exploitation block needs a certain size (to be calculated on local conditions), which it does not have at this moment (now smaller). This means forest management needs to be carefully organized and any additional forest in an Exploitation block should be allocated based upon the legal conditional application of a sustainable rotation schedule and Sustainable Forest Management principles. If not properly applied the license should be revoked. This has to be organized in Mozambique and probably needs additional legislation, training and awareness raising.

It seems that this methodology (ACM0021) is feasible to implement in Mozambique if sufficient scale can be organized.

Conclusion

The previous chapter shows that there are established Charcoal Producer Associations (app. 7) that are sufficiently organized to become partners in a climate-financed activity as discussed here. The Charcoal Producers Associations could form the center of pilot activities. There are also forest plantations companies that might be interested to get involved. Maybe residues can be used from existing plantations although the willingness of companies to produce such charcoal and of consumers to buy it has to be assessed. However, in general

pine and eucalyptus are not used for charcoal in Mozambique and the companies could use and plant other trees (like Mopani). An industrial-scale production could be based on either biomass residues or licensed woodland plantations. In that sense they would not differ from Producer Associations. The two types of organisations – Associations and Companies – should be considered the implementation channels. The CPAs will probably not be sufficiently organised to provide the legal basis for direct recipient of foreign funding. An in-between organisation is needed, especially if additional revenue may be gained from emission reductions achieved.

Methodology ACM0021 seems applicable (see text above). A standardized baseline in combination with this methodology seems an option.

Additional questions to be answered in the Climate Financing Feasibility study (next phase) are:

- What support measures and activities are needed to make existing Charcoal Producer Associations (CPAs) eligible?
- What kind of umbrella government-related agency is needed to receive and distribute climate-financing?
- What is a proper timeframe for implementation of a PoA in relation to necessary institutional changes and carbon price developments?
- What is the scale to which the initial Charcoal Producer Associations (CPAs) in the PoA can be expanded to the whole sector? i.e. in what feasible timeframe and how can CPAs and forest plantations obtain a formal license for charcoal production?
- Will the PoA lead to sufficient emission reductions, how many carbon credits can be obtained from advanced kilns in licensed communities and at what price?

5.2 Option Nationally Appropriate Mitigation Action (NAMA)

Whereas the CDM provides a way for developed countries to help meet their emission reduction targets through purchase of additional project-based emission reductions from developing countries, Nationally Appropriate Mitigation Actions (NAMAs) are primarily conceived as a way for developing countries—with financial and technological support from the international community—to make progress in reducing their own domestic emissions. Following the way NAMAs were formulated in the Bali Action Plan, these include policies and measures that, in the context of the sustainable development goals of the host country, contribute directly or indirectly in a measurable, reportable and verifiable manner to the mitigation of GHG emissions. The policies and measures can be implemented at local, provincial/regional or national level.

A charcoal-related plan may be developed under the flag of NAMAs. In the framework of this study and in order to properly assess the opportunities under NAMA, the following can be stated:

- Currently, there is a broad array of NAMA ideas but few concrete approaches.

- The regulatory framework is still unclear, there is lack of guidance on NAMA design. This however also provides opportunities as early movers will contribute in setting the scene.
- Both CDM PoA and NAMA are similar as for: (i) they support and implement low carbon development activities and strategies; (ii) they require documented evidence of GHG reductions by use of MRV Systems and (iii) they focus on the implementation of broad based GHG mitigation programmes. In the case of NAMA support can also be indirect and focus on improving conditions, e.g. improving the regulatory framework or enforcement. The MRV system in the case of a NAMA can also be on indicators that are not directly linked to GHG reductions: e.g. number of licences delivered (if the NAMA is conceived to improve the implementation of the licencing system)
- A key role in implementation of a NAMA is the government (state, provincial, local) of the country for which the NAMA has been formulated as it is a voluntary action of a developing country to make progress in reducing their own domestic emissions.
- A CDM PoA can grow into a NAMA, but it might also evolve into the New Market Mechanisms (NMM, which are currently under development).

NAMAs can be financed through public and private financing, both domestic and international. International public financing can be bilateral, multilateral or from specific funds such as the Green Climate Fund.

A NAMA allows more flexibility than CDM-projects because they are not limited to the specified UNFCCC methodologies. The following table summarizes the key differences between CDM PoA and NAMA:

Table 6: Differences between a CDM PoA and a NAMA.

CDM PoA	NAMA
Emission reductions used for Annex-1 country Kyoto compliance	Emission reductions used for NAMA country targets. Exception for market-based NAMA to be decided
Coordination via private or public sector	Coordination most likely by government only
Baseline and monitoring via CDM methodology	Baseline and MRV system not yet defined
Financing through market-based mechanisms	Market mechanism only an option
Defined by PPD and CDM methodology	Broad, sectoral approaches beyond CDM possible

Source: KfW Carbon Fund (2011)

The key defining criteria for a NAMA are that it directly or indirectly leads to measurable, reportable and verifiable emission reductions activities by developing countries in the context of sustainable development. Under a NAMA, various activities throughout a sustainable charcoal value chain (ranging from production to consumption) may be formulated that are linked to conditions (e.g. improved enforcement of existing legislation) rather than direct

emission reductions. The NAMA could help to organise the charcoal value chains throughout Mozambique. For example:

- ✓ Enforce current legislation and government monitoring of production and transport.
- ✓ Support the licensing system by organisation and legal establishment of new Charcoal Producer Associations in other provinces.
- ✓ Establish sustainable rotation exploitation blocks and management system for charcoal producers and introduce improved methodologies that directly lead to emissions reductions (use of dried wood, better earth kiln to be followed by improved kilns).
- ✓ Support the forest use planning and zoning of charcoal producer areas by the government and prohibition and enforcement (also through satellite monitoring) in other forest areas.
- ✓ Establish a policy framework and legal conditions under which forest plantations can produce charcoal for consumers and/or industry.
- ✓ Develop a formalised Brand (controlled and issued by one organization) and supportive marketing towards urban consumers to enhance awareness and sales.

5.3 Other sources of climate-related financing

There are two other climate-financing possibilities:

Reducing Emissions from Deforestation and Forest Degradation (REDD+)

At the Conference of Parties (CoP) of the UNFCCC, the Reduction of Emissions from Deforestation and Forest Degradation (REDD) has been discussed for many years. At COP12 (2006 Nairobi) the parties decided to conduct further work and establish baselines in order to measure REDD. In support of developing countries who wanted to become ready for REDD, several organizations launched initiatives: for example The World Bank launched the Forest Carbon Partnership Facility (FCPF) and the UN-REDD Program (the United Nations collaborative initiative on REDD supporting 48 partner countries to develop national programs). At the 2013 COP19 seven decisions in relation to REDD were taken¹⁴:

1. REDD+ finance: Result-based finance for country action may come various sources, including the Green Climate Fund.
2. Coordination of finance (in the joint SBI/SBSTA): Interested parties are invited to design a national entity or focal point.
3. National Forest Monitoring Systems (SBTA): Governments decide how they define 'forests'. The system should be based on the available methodological guidance.
4. Summary of information on safeguards: To be provided on a voluntary basis.
5. Forest reference emission levels: Countries may (voluntary) submit a forest reference and/or forest emission reference level to be technically assessed in the context of results-based payments.
6. Measuring, reporting and verification of forest-related emissions. The system should be transparent and consistent over time. Parties should report every two years.
7. Drivers of deforestation and forest degradation: Encourages parties to take action.

¹⁴ <http://www.redd-monitor.org/2013/11/25/what-came-out-of-warsaw-on-redd-part-1-the-redd-decisions/>

REDD implementation is the responsibility of the host countries and their national laws. Various non-governmental organizations criticize the REDD mechanism for infringing on the rights of local and indigenous peoples (they have the customary or formal land rights and should benefit financially from keeping forest standing, not the treasury).

A major REDD-related initiative in Mozambique was the South-South REDD, a co-operation between Brazil and Mozambique with financing from Norway.¹⁵ The purpose of the project was to create the conditions under which Mozambique is able to implement a REDD-project. The initiative ended in 2012. A major result was the development of the REDD+ readiness preparation proposal (RPP). Mozambique's RPP was formally submitted to the FCPF in January 2012 and approved in March the same year. As a result, Mozambique has the opportunity to access USD 3.8 million to establish a REDD+ strategy, policy and institutional framework, and the reference level and monitoring systems for emissions reduction.

In 2010, the company MozCarbon (30% Dutch company Pan-African Carbon Initiatives, 70% Eduardo Mondlane University) started under the name Mozambique Carbon Initiatives. The objective was to develop and implement REDD projects. They have not materialized yet as the country did not have a REDD national framework. The company now also includes energy use and cookstoves. They have currently 18 Project Idea Notes of which 10 are REDD related but none are yet implemented. They are currently implementing a cook stoves project with a grant from the Energy for Environment Partnership.

In conclusion, Mozambique is slowly moving towards being ready for REDD+ project implementation but experience is yet limited. At the moment REDD-financing does not seem an attractive option. Capacity building activities may be financed.

Voluntary carbon credits

A carbon credit represents a tonne of CO₂-emissions and can be formally related to the CDM (the Certified Emissions Reduction credit). There is also a voluntary carbon credit market that can be bilaterally or through a formal exchange. The most popular type of carbon credit used to offset emissions voluntarily is a VER: a Verified or Voluntary Emission Reduction unit. There are many different types and often smaller projects and projects that have difficulties to comply with the large-scale UNFCCC CERs for compliance purposes, go for the voluntary market. These VERs can be verified to a number of specific standards, including the Gold Standard¹⁶. The Ecosystem marketplace by Forest Trends provides an annual report on the status of the voluntary market.¹⁷ In 2012, voluntary actors contracted 101 million tonnes of carbon offsets (MtCO₂e), 4% more than in 2011. The vast majority is traded bilaterally and while the overall market grew, the market value decreased 11% to US\$ 523 million. Overall the price of a VER decreased to an average of US\$ 0.1 per tCO₂e. Project developers include companies, government entities and non-governmental organisations (NGOs). In 2012, the private sector bought 90% of offset credits, mostly for Corporate Social Responsibility (CSR) or marketing purposes. The credits cannot be used for compliance with targets under the Kyoto

¹⁵ <http://www.iied.org/south-south-redd-brazil-mozambique-initiative>

¹⁶ http://en.wikipedia.org/wiki/CDM_Gold_Standard

¹⁷ <http://forest-trends.org/vcm2013.php>

Protocol and the UNFCCC. Multinational corporations in North America and Europe transacted the largest offset volume of any business category (27 MtCO₂). Close behind these organizations were offset buyers from domestic small- to medium-sized enterprises, 82% of which were Europe-based. Already a small portion of this market volume could have a significant positive influence on charcoal producers in Mozambique.

There are few carbon-offset projects in Mozambique. The company Envirotrade supported by CarbonNeutral Company (UK) implements a forest project in Sofala province at Gorongosa National park (Nhambita community) that sold voluntary credits. Basically the projects pays local farmers for reforestation for a 7-year period after which it is assumed that the trees will provide sufficient income for 99 years maintenance. In 2007, Envirotrade established a Mozambique Carbon Livelihoods Trust (MCLT) to safeguard the interests of communities and individual farmers through payments for sequestered carbon. Approximately one third of the proceeds of any carbon sale go directly to this fund, which is used to pay individual farmers over seven years, to make annual contributions to a community trust fund and other payments for forest management and conservation. The MCLT Committee is constituted of program partners - one representative from each community association participating in the project, Envirotrade, and WWF Mozambique (which is responsible for ensuring that funds are properly managed and payments made). An accounting firm based in Beira, is responsible for the daily management of the fund, and the fund's transactions are monitored by BioClimate Research and Development (BR & D), an organization based in Edinburgh responsible for certifying Plan Vivo standards. According to Friends of the Earth, the project has run into financial problems (sale of credits does not cover costs) and is criticised by local people that sometimes fail to understand the concept of carbon trading and signed a contract of which they do not understand the implications (payment for 7 years and maintenance for 99 years).

In conclusion, the voluntary carbon market is in theory an attractive option for climate financing especially when prices are higher. However, projects have to be developed in a similar way to formal (UNFCCC rules) credit financing and Government-to-Government financing under the UNFCCC may be more predictable on the long-term.

6 Emission reductions and co-benefits

6.1 Benefits

The most obvious and promising result to be achieved by using climate financing for improving the charcoal sector is direct emissions reductions from (1) improved kiln design and (2) forest management. Other measures lead to emission reductions in an indirect manner, which are often of equal importance and have an impact on a higher/wider scale. More details can be found in annex 4.

Important co-benefits can or should be achieved by improving the charcoal production. First and foremost, it has to have positive economic and financial benefits for the producers, the government and the consumers. Without significant pro-poor effects and economic viability the measures will not be supported.

In the light of a NAMA not only emission reductions are important but also other positive effects related to sustainable development. Important co-benefits that need to be quantified in the next phase of the feasibility study (when the potential CPA-partners and their regions have been identified more clearly) are:

1. Income generation for the licensed producers and their employees;
2. Economic effects on the related communities;
3. Health effects of improved kilns and operations;
4. Environmental and biodiversity effects of reduced forest degradation
5. Effects on women empowerment (gender)

6.2 Options for direct and indirect emission reductions

Research and experience show that the whole value chain should be considered with all stakeholders and their needs to achieve measurable, meaningful and sustainable results. Based upon the information provided in the previous sections one can conclude the following:

1. To obtain meaningful results from a climate perspective, the charcoal production techniques have to improve by (a) not use wet/'green' wood; (b) better earth kilns; (c) highly efficient modern kilns in a fixed place (one per exploitation block);
2. Local producers have to be well organised in a Charcoal Producer Association or through a company to become able and eligible to co-operate within a project;
3. Because existing CPAs include a large numbers of producers (1,000+ with around 6 kilns each) and covers an extensive area, a meaningful project can be realized by working with a few CPAs (approximately 7 are sufficiently organised);
4. The capacity of local organisations – CPAs, NGOs and government – to monitor verifiable outputs is currently weak and has to be organised from the start and demands an independent strong monitoring entity with a legal mandate to receive and allocate funds and conduct monitoring and reporting.
5. Co-operation between government, private sector and local producers is needed to establish economically sound, commercially viable, socially acceptable and

ecological sustainable charcoal production to the benefit of local communities and the Mozambican economy.

Basically this means that biomass production should become organised and efficient as well as use more efficient production techniques.

In annex 4, a list has been drafted based upon the information in this report with direct and indirect emission reduction measures throughout the charcoal value chain. Most emission reduction gains, and thus measures, relate to forest management and production. The government of Mozambique is the key actor in the implementation of these measures as they determine the 'playing field' for producers and the long-term viability of the sector by regulation, forest monitoring, enforcement and taxation, and re-investment of revenues in sector performance (also argued by the BEST study).

6.3 Potential business models

Several key actors and models for co-operation can be considered:

The charcoal sector is big and money can be made. However, for *foreign investors* this market will be of limited interest as export of biomass is currently prohibited by law by the government and will not be very attractive in the nearby future (lack of infrastructure, high cost of transportation). Because fire wood and charcoal are mainly used by the poor this export ban is very understandable. In theory companies can find an attractive market in Mozambique itself. Large forest plantations for domestic production might be an option but face some challenges (see option 2).

FUNAE has implemented a project with *local charcoal producers* whereby they received training on using modern kilns. There are no examples of operational modern kilns at this moment. No project went beyond the pilot phase as communities returned to their traditional ways of charcoal making. This is attributed to the fact that modern kilns are in a fixed location and it takes more time (the wood has to be cut in smaller pieces and be transported over longer distances). FUNAE could not provide more information. There is for example no information on the conditions under which these projects have been implemented, especially on (1) the level of organisation of the producers; and (2) whether the wood was readily available or a limited resource (this report argues both are conditions to be met before implementation of a producer-related charcoal project).

Working with *companies and local entrepreneurs* is also a possibility and has not been piloted at scale before. Various projects have tried briquetting of forest and agriculture residues like the Solidaridad-Electrabel project (which did not continue) and the on-going SNV/Eduardo Mondlane University project. So far, no project has become commercial as they are faced with various constraints in relation to the source and type of waste material:

1. *From smallholders*: this waste stream is not organised, which means a lot of effort has to be put into the development phase. This has been tried in various projects that all failed because it proved difficult to organise the producers at scale, collect the waste in an affordable manner and the 'production' proved volatile.

2. *From industry:* most waste streams from industry plantations already have a value. Bagasse from sugar cane is very valuable for co-generation and ethanol production, banana residues are used for the production of biogas (which will also be high potential for other industries). The briquette producer cannot compete with these uses. The waste from forest plantations in the Center and North of the country is not used in a commercial manner. They burn the sawdust or leave it to rot.

Our conclusion is that briquetting of agriculture residues as a stand-alone commercial activity is not viable in Mozambique. Briquetting from forest plantations might be a commercial option. For private sector involvement, the competition from the informal sector that does not pay any fees is a major obstacle to be addressed.

Given these constraints the following options for market-oriented production and business opportunities have been identified. From interviews and our experience the most promising models all include ways of co-operation between producers, companies and government (see par. 6.3). Please note that one opportunity does not necessarily exclude the other.

1. Charcoal Producer Associations (CPAs)

The experience with the failed community projects suggests that certain pre-conditions have to be met before a project can be attempted. Modern, fixed kilns can be introduced but the difference with the previous failed introduction should be:

15. Each individual member should have legal, inheritable user rights according to DUAT.
16. A crucial element is that an established level of organisations is already present showing producers want to co-operate with each other i.e. Charcoal Producer Associations have to exist. They also have to be functional. The Association has to show that it has allocated exploitation blocks to its members and monitors implementation and licenses. The members show accountability towards each other and government.
17. The members have to show that they run an already financially viable charcoal making business.
18. The forest is currently degrading and producers feel the economic pressure of unsustainable use and the viability of their business.
19. There are yet no successful examples in Mozambique with sustainable forest management. Thus the members have to encounter problems with the availability of trees within their exploitation block and are aware that this practice cannot continue. They accept sustainable forest management practices and re-planting are needed.
20. The resource is/can be limited by a licence and by allocating, inheritable exploitation blocks to individual license holders;
21. Improved kilns should not be a communal operation but rather the responsibility of individual members with one fixed kiln per exploitation block, In addition they can use some traditional earth kilns whose performance can be improved as well by chimneys. This will introduce some competition between members as some individuals will fail to maintain these operations and others will thrive (probably those who are more entrepreneurial).

Basic information suggests there are – at least two and maybe seven - CPAs that meet these pre-conditions. All these CPAs do need additional capacity building support related to administration, monitoring and reporting. Through these CPAs individual members have to be targeted and made responsible.

2. Government or Company owned forest plantations (with and without linked small producers)

Mozambican government and companies have experience with industrial-size plantations but they do not seem a grand success (see par. 3.3). The plantations all plant eucalyptus and pine trees (fast growing species) for paper and construction industry. No plantation uses native species and they do not link to small producers. Some plantations have been criticized on taking more land than was allocated to them under DUAT. Challenges regarded establishing forest plantations:

- Pine and Eucalyptus grow much faster than native trees but are less suitable for charcoal production. The license should therefore only allow planting of native trees, otherwise the plantation would sell the wood to other markets;
- The plantation has to get a DUAT- license to make use of that land for commercial purposes and be sure to have a clear agreement with local communities. Participatory Land Use Planning with community mapping is advised to avoid land boundary conflicts.
- Plantations should avoid regions with high levels of cattle grazing or wild herbivores (like elephants). They will eat the seedlings if not protected.
- Uncontrolled fires are frequent and will destroy young trees. People often set fire to the grasslands in order to clear from animals and open areas for crop production. This can quickly spread out of control. It is necessary to clear fire-breaks around plantations. Secondly, native Miombo trees can survive forest fires and re-grow relatively fast.
- Theft of trees (illegal logging) is another concern once the plantation is mature. However with large plantations this becomes negligible.

On the other hand, a well-established company can produce at a scale and with an efficiency that can have a meaningful impact on emissions reductions and the market. Given the Mozambican context and to avoid land speculation, it is important that an investor is a well-established and reputable company. When forest plantations meet the raised concerns they can be socially acceptable, sustainable and probably commercially viable.

3. Technology provider on efficient kilns to CPAs

Currently several modern carbonization technologies exist, which work through the process of torrefaction. Such kilns have the potential to drastically reduce the amount of feedstock needed within the carbonization process. Whereas traditional earth kilns require an average of 7 kg of wood for 1 kg of charcoal; torrefaction can reduce this ratio to 2-1 (Atanassov). Such kilns can be designed to the specifications of the local context, and may vary in size as well as be fixed or mobile. With the correct technology, it is also possible to integrate methane abatement within the process. A torrefaction unit is currently outside the reach of charcoal producers (financially and skill-wise). Secondly, many producers currently sell 'at the gate'. The prospects for reduced feedstock requirements, as well as a faster carbonization process (from 2-4 weeks using traditional kilns – to just a couple of hours using torrefaction)

could make this option also attractive to producers. This creates a commercial opportunity for a company to integrate itself within the charcoal value chain as technology provider of efficient kilns (similar to Business Development Services in any agriculture value chain). Two implementation models can be identified, based upon their local viability:

1. One large central torrefaction plant is established within the community grounds. Charcoal producers may bring their feedstock (from their individual forest blocks) to this location for torrefaction. The producer pays per load torrefied, and may package and sell the charcoal from this centralised location.
2. Small torrefaction units are set-up on individual producer blocks. The producer can hire this unit from a company and is trained on how to use the technology, and is responsible for its operation. Or the producer takes a loan for this unit and a payment system of instalments cover the unit costs over time. Because the producer is limited to a certain legal amount it means he/she saves time that can be used for other purposes. He/she may not produce more. The first option seems therefore more realistic.

Another option is that a company buys the raw material from the producers and retails the torrefied product in the urban areas. Producers would accept this option probably only if the company pays more than they would otherwise earn (more transport needed, but less labour present in the field to manage the earth kilns). The commercial incentive for a company to introduce torrefaction, lies in the premise that the company buys and sells the torrefied charcoal (i.e. the retail of the charcoal). If acceptable to communities and local producers, this approach has several benefits, namely:

- o The introduction of an efficient carbonization technology to producers whom otherwise could not afford it. The company finances the technology and assumes the risks of this investment;
- o The assurance of maintenance of the equipment, as it is in the interest of the company to have continuous production;
- o A new brand of sustainable charcoal becomes available in the market, probably at competitive prices but without pushing existing producers out of the market;
- o Existing producers are integrated in a sustainable charcoal value chain;
- o Monitoring and compliance with carbon financing requirements is feasible, as a result of a structured production and supply programme.

4. Briquetting of waste material

This report argues that use of agricultural residues is not commercially feasible. Forest residues from pine and eucalyptus and logging operations might be a source for briquetting. However, the wood is not popular for charcoal making in Mozambique and in other countries this residue is often used for higher-level purposes (pressing into chipboards for example). Building a market chain on this resource seems un-viable but can be discussed in more detail with industrial plantation owners.

The current practice of charcoal making leaves a high amount of small charcoal in the field. These small pieces could either be collected and marketed at lower prices targeting poorer urban consumers or could be used to produce briquettes. Basic commercial sense suggests

this can only be done in combination with other activities with CPAs as higher efficiency kilns will reduce the amount of small pieces. This activity is thus an add-on but could be organised as an important pro-poor activity by including vulnerable (e.g. women) groups from the community. This activity would require a revenue-sharing agreement that is acceptable for the community groups as well as the owner of the kilns (the charcoal producer).

6.4 Organizing the market: Umbrella Legal Entity needed

Given the huge implementation challenges and all failed attempts so far, we feel a project to enhance sustainability in the charcoal sector should not be merely another project piloting a new model. From the start it should involve all major stakeholders to ensure long-term commitment. A Tripartite Partnership including the government (Public), companies (Private) and Charcoal Producer Associations (People) seems an attractive co-operation model. The information in this report – and supported by the BEST study – shows there is a need for a government related entity that supports the development of a sustainable charcoal sector.

This could be an independent entity called 'Biomass Energy Agency' (as suggested by the BEST study) with a steering committee in which all stakeholders are represented (like in Water Resource Management Organisations) or it could be another co-operation model acceptable to the Government of Mozambique and reporting to the Inter-Ministerial Commission on Biofuels and Biomass. In general, this organisation needs to:

- Be a legal entity to be able to receive climate financing and other official funds;
- Organise the value chain and establish an equal playing field;
- Ensure production does not infringe on people's rights (DUAT) and is sustainable (no forest degradation, positive GHG-balance);
- Support branding and marketing of sustainable charcoal;
- Able to distribute funds in an appropriate manner based upon a high-quality assessment of submitted project proposals based upon pre-defined criteria;
- Because the ambition is to establish a sustainable economically viable market chain, proposals should not be based on 100% subsidy but rather be based on a set of principles related to a % own contribution (cash or in-kind) and/or re-payment of loans (revolving fund?).

The mandate of such an entity, operations, staffing need and institutional linkages (embedded in an existing organisation, branch or new entity) has to be researched and discussed in more detail with the government of Mozambique (in February workshop and subsequent steps). Some institutional examples exist in Mozambique:

Example 1: The organisation *FUNAE* is well-established in Mozambique and functional. It already has some experience with charcoal and a biomass energy department. *FUNAE* facilitates donor-funding, finances projects and supports to some extent private sector development. Much can be learned from the recent evaluation on the pros and cons of this government entity.

Example 2: The *Agrarian Development Fund* (*FDA – Fundo de desenvolvimento Agrário*) is responsible for the advancement of government and donor funded projects within the

agriculture and forestry sector. FDA has been responsible for several reforestation campaigns within the country, and has a vast experience in working with small-holders, producer-associations and communities. The Fund has no charcoal related projects to date, however has shown interest in collaborating for the establishment of such projects.

Example 3: The Beira Agricultural Growth Corridor Initiative is a partnership between the Government of Mozambique, private investors, farmer organizations and international donor agencies. It was launched in 2010 and aims at promoting increased investments in commercial agriculture including smallholders. Its main element is the Catalytic Fund managed by AgDevCo (from the UK), which supports numerous small projects with funding ranging from US\$50,000 to \$500,000. The Catalytic Fund is a revolving fund and seeks to recover its capital and make a financial return (likely to be in the range 5-10% in USD terms overall). All returns are re-invested into new investment opportunities.

Example 4: FIPAG stands for Fundo de Investimento e Património do Abastecimento de Água (FIPAG) and this is the national asset holder for water infrastructure in 19 cities. Through a partnership agreement FIPAG is supported by the Dutch Water Utility Company Vitens Evidens International (VEI). FIPAG is responsible for planning and managing its water infrastructure assets in a sustainable (financial, institutional, social, environmental) manner. However, water is actually delivered to the consumers by 18 private water operators. These water operators will be run as a commercial business, independent from FIPAG as asset holder and will operate under the name of 'FIPAG Serviços'. VEI contributes its management and operational experience.

7 Findings and recommendations

This chapter presents the first draft findings and recommendations that will be verified with stakeholders in the February 2014 workshop that will lead to the subsequent assessment of feasibility of climate financing.

7.1 Potential emission reductions

In Mozambique, the traditional, unimproved earth kilns are the baseline technology used throughout the country. There is no autonomous improvement in technology used by the producers from the informal sector to be expected even though charcoal prices are increasing and forest degradation is perceived. Among organized and market-oriented producers, there is a willingness to (also) use modern efficient kilns if such support would be provided. They will not build such kilns by themselves as they have no access to such knowledge and credit schemes (if needed). They might introduce chimneys if they new how to use them to regulate the carbonization process. They have expressed a willingness to co-operate with a project and indicated to be willing to invest themselves as well.

This paragraph provides an assessment of potential emission reductions. It does not provide a Standardized Baseline for Mozambique nor does it fully calculate or assess feasibility of the options in emissions reduction terms according to UNFCCC methodologies. This calculation is part of the Climate Financing Feasibility Study in the next phase.

The main emission reductions can be achieved through sustainable forest management and efficient kilns. The basic figures of the previous chapter are used to calculate potential impact in emission reduction terms. The default values used are the same as in the Standardized Baseline for Uganda and as listed in the consolidated GHG database:

Table 7: Default values

Parameter	Description	Default value	Unit
K _{CH4}	Emission factor for methane emissions for the informal charcoal sector	6.5128	† CH ₄ /t charcoal
K _{CO2}	Emission factor for CO ₂ emissions for the informal charcoal sector	0.0382	† CO ₂ /t charcoal
CC _i	Carbon content in wood	0.45	† C/t wood

Source: Standardized Baseline Uganda

For a standardized baseline and/or project proponents use can be made of the fraction of non-renewable biomass (fNRB). The share of non-renewable woody biomass in the total biomass consumption for Mozambique is determined at 91% (UNFCCC SSC 35th meeting report, Annex 20).

Efficient kilns

Mozambican producers use earth kilns which have an average efficiency of 7 : 1 (14%) with a range of 10-20%. If they use wet, 'green' wood the efficiency becomes lower and with dry wood and a good, large construction the efficiency becomes higher. On average one kiln

produces 2.8 tonne charcoal (40 bags of 70kg) per batch for which 19,600 kg wood is needed. On average there are 6 earth kilns per exploitation block.

Because a charcoal producer is allowed to produce annually 1,000 bags of 70kg charcoal the emissions are calculated per producer and not (yet) per kiln to estimate relevance of introducing efficient kilns. A producer may legally produce 70 tonnes of charcoal per year. Efficient production leads to less carbon dioxide and methane emissions. In the case of methane, direct destruction seems not applicable (yet) in the context of Mozambican producers but avoidance of methane production through more efficient kiln seems possible (no default value available).

Current production equals 2.674 t CO₂e (from CO₂) + 9,574 t CO₂e (from 455.896 t CH₄) = 9,577 t CO₂e / per producer / per year. One CPA may include 1,000 producers and thus equals approximately 9.6 kt CO₂e/yr.

Because of the legal limitation the producers will use less wood to produce the same amount of charcoal (otherwise he would produce more charcoal with the same amount of wood). Modern, efficient kilns can reach an efficiency of 30-40%. With a modest efficiency gain of 20% one Charcoal Producers Association may achieve already significant emission reductions.

Sustainable Forest Management

Forest management is and will not be an issue for remote illegal producers that can access the wood for free in a forest area. This changes when the resource is no longer abundant or free as now occurs in the vicinity of Mozambican cities. The main incentive for a charcoal producer to become a sustainable forest manager is that he gains the legal, inheritable user rights for one forest exploitation block. Wood is no longer for free but a limited resource that has to be managed properly. Illegal logging and theft becomes subsequently a major concern. Whether this can be controlled has to be discussed with the CPAs.

With the current earth kilns a charcoal producer needs 470,000 kg wood to produce its 1,000 bags with 70kg charcoal. Given the legal restriction of 1,000 bags, an efficiency gain of 20% would mean 94,000 kg less wood to produce these 1,000 bags. *This would mean that one CPA could realize a reduction of 94 million kg (94,000 tonnes) of wood. This is about 313,000 less Mopani trees per year to be cut (estimated 0.3 tonnes per Mopani tree of 25 cm).*

The capital Maputo (population 1.6 million) and connected Matola (761,000) is the main consumer market. With an average household size of 5 persons this means the Maputo-Matola area has 472,000 households. With 35% of households¹⁸ using one 70kg bag/month per household they consume 11.6 million kg charcoal per month (139,000 tonnes per year). With a modest efficiency gain of 20%, this means 194,880 tonnes of wood (27,800 t charcoal x 7) less to produce the same amount of charcoal. This is approximately equal to 649,600 Mopani trees of 25 cm less cut in a year.

¹⁸ A conservative estimate as 70% of the households have LPG or electricity but also use charcoal.

The moment forest re-growth is in balance with charcoal production, the charcoal can be considered a sustainable, renewable energy resource. When establishing a carbon balance for a Miombo woodland one should bear in mind that a considerable amount of carbon biomass is stored underground. The current forest management practices cut the Mopani trees at 30cm height for re-growth and leave the underground untouched. This practice should continue and the survival rate of Mopani could be increased (and thus increase the density of trees per hectare).

7.2 Findings to be assessed with stakeholders

Feasibility assessment of business models

- *Charcoal Producer Associations (CPAs)* exist in Mozambique that are rooted in the communities and have / can have legal land rights (under DUAT). Seven of them seem capable, well-organised and in control and when they are established as legal entities and with capacity building they can be recipients and partners in projects that establish sustainable forest management and improved kilns. How many there are exactly is unclear. The CPAs are key partners for successful implementation.
- Companies owning *forest plantations* in Mozambique do not have experience with charcoal production. Most plantations plant pine and eucalyptus, which are not suitable for the Mozambican consumer market. The existing plantations are not major commercial successes and may receive criticism from discontented local people. At the moment they do not seem major partners but their future involvement should be considered as they can be highly efficient and create a competitive market. It is however also very likely they do not want to produce charcoal but rather timber for construction and pulp for paper.
- *Charcoal Business Development Services*: Companies and small entrepreneurs involvement should be stimulated to develop supportive services like the transfer of technology related to (1) Mopani tree nurseries; (2) efficient kiln technology and transfer of expertise; (3) methane abatement technology and flaring; (4) micro-credits for charcoal producers; (5) Monitoring and reporting by independent and certified consultants/companies.

Feasibility climate financing

- A *CDM Program of Activities (PoA)* needs a formal and legal entity that can receive and distribute climate financing (from CERs) and monitor and report verifiable results. Most of the charcoal production is however informal. Some good Charcoal Producers Associations exist that can be used as pilots for co-operation. The next hurdle is the potential application of CDM methodologies related to charcoal. Two (one demands inclusion of consumers and one demands methane abatement) do not seem feasible at this moment. The third (ACM0021) focuses on reduction of emissions from charcoal production by improved kiln design and/or abatement of methane. Improved kiln design is feasible. It seems possible to develop a standardized baseline for Mozambique based on the co-operating CPAs and their regions.

- With the CPAs sufficient scale can be organised to merit climate financing, either from a CDM PoA or NAMA (Nationally Appropriate Mitigation Actions). Besides direct emission reductions support could be provided to establish the needed enabling framework (institutions, partnerships, legislation, monitoring and enforcement, etc).
- Mozambique has some experience with project developers selling voluntary carbon credits (not all positive). Under the umbrella of a clear framework defining the rules of the game, charcoal production projects can also become eligible. The CPAs and their producers need good information and support before they enter into deals.
- The CPAs should be the ones selling the carbon credits or benefit from other climate financing in case of a NAMA under set conditions for re-investment in forest management and kiln efficiency. Various CPAs seem sufficiently organised to establish contracts and schemes that can report verifiable outputs necessary for climate financing. The CPAs are large in number of associated producers and hectares under forest management so scale can be reached.

Impact

- *Local level impact:* There are potentially 7 functional Charcoal Producer Associations that seem sufficiently established to be a partner in a project. In closer dialogue with the Min. of Agriculture/Forest Department and Provincial governments, other CPAs might be identified. They are legally limited to produce 1,000 bags of 70 kg charcoal per year on an individual license. Many producers are faced with forest degradation challenges and worry about the future of their business. These producers would profit mainly from establishing production areas of a sufficient size and establishing sustainable forest management. They cannot produce more bags. History shows that the price of a bag of charcoal increases each year (15% on average. See 4.2.4) and is a profitable business. They can thus continue their profitable business.
- *Climate relevance:* A charcoal producer is allowed to produce 70 tonnes of charcoal per year. Current production equals $2,674 \text{ t CO}_2\text{e (from CO}_2\text{)} + 9,574 \text{ t CO}_2\text{e (from } 455.896 \text{ t CH}_4\text{)} = 9,577 \text{ t CO}_2\text{e / per producer / per year}$. One CPA may include 1,000 producers and thus equals approximately $9.6 \text{ kt CO}_2\text{e/yr}$.
- *Local and national forest cover:* The estimated 472,000 Maputo-Matola households alone consume between 139,000 – 297,360 tonnes of charcoal per year for which 0.9 - 2 million tonnes of wood (at an average 7 :1 ratio) is needed. Any increase in efficiency of production and monitoring of compliance with issues licenses would mean less trees have to be cut. Given the enormous amount of trees used to produce this charcoal, this would have a huge impact and reduce forest degradation both locally as at national scale. An efficiency gain of 20% would mean 0.18-0.4 million tonnes wood or 0.6 -1.2 million less Mopani trees per year to be cut (estimated 0.3 tonnes per Mopani tree of 25 cm).

- *National level economics*: An efficiency increase to 40% (2.5 : 1) means less wood is needed. Assuming all seven organised CPAs become involved and they have an average of 1,000 members, these 7,000 members produce 7 million bags of 70 kg each year. This is 490,000 tonnes of charcoal. The efficiency increase means 1.6 million tonnes less wood is needed.

7.3 Stakeholder consultation and follow-up

- The Charcoal Producer Associations play a key role. The findings and potential business opportunities (discussed in chapter 6.2) should be discussed with them to identify their preferences, willingness to co-operate and feasibility of actions. It should become clear to them that carbon financing from emission reduction may be a source of revenue but it also comes at a (transaction) cost (time, organisation and other investments).
- Companies present at the workshop could indicate which commercial opportunities they see in charcoal sector related 'Business Development Services' and indicate their willingness-to-invest.
- It is recommended that the government partners clarify what is needed to enhance their capacity for monitoring the licenses and forest management practices in co-operation with CPAs and an independent monitoring authority. They are also recommended to clarify if they want to re-invest charcoal license revenues and fines into the sector.
- It is recommended that the requirements and mandate of an umbrella entity (see chapter 6.2) is discussed with all stakeholders. Subsequently, the government of Mozambique – represented by the Inter-ministerial Commission on Biomass (CIB) – could make clear if and how they want to organise such an entity and with what mandate.
- The current capacity of the seven potential CPAs could be assessed in detail in order to establish whether they can be (come) responsible and reliable counterparts in the required monitoring of verifiable results. Questions to be answered is how they are organized (board, general assembly, secretariat, type of decision-making system, level of administration, Monitoring and reporting etc).
- The promising business models could be worked out in more detail to become projects that are eligible for climate financing or another form of donor support.

Annex 1 : Project approach

The project approach as presented in the original proposal by EES Engineers (2013). Additional research questions have been defined and presented in a Research Plan to the Government of Belgium at the start of the assignment. The research questions are presented under work package 1.

Work Package 1: Literature and Field Research, including Research Questions

Background

Sustainable production of charcoal is not a new discussion within Mozambique. Publications such as "Making charcoal production in Sub Sahara Africa sustainable" and the "Mozambique Biomass Energy Strategy (BEST)" have made a first assessment of the charcoal sector, its stakeholders, its problems and its opportunities. Key for this assignment is to use this existing knowledge and to take it to the next practical level; namely how can we mobilize the sector to organize itself in a sustainable manner meeting CDM/PoA requirements. This study is to lead into an outline of the programme and into an overview of sector stakeholders and visions and intentions to participate, resulting in realistic and bottom-up activities.

Data will be collected through literature research and through field research. First it will be assessed what literature exists and can be used to study the relevant topics. If there is not any literature, the data will be collected if possible. There are 5 key categories of stakeholders that will be contacted and visited, namely:

1. Central Government
2. Provincial/Local Governments
3. Transporter/Middleman/Wholesaler/Retailer]
4. Charcoal harvesting/producing communities
5. (Potential) private charcoal companies

1	An overview of the current methods/technologies used for charcoal production (type, efficiency, importance in the Mozambican charcoal production, ...)
2	An overview of traditional feedstock's used for charcoal production
3	An overview of actors involved in the production process
4	An overview of past initiatives to improve the sustainability of charcoal production, their impact (including change to a more sustainable feedstock, improved charcoal kilns, improved kiln preparation and management, ...) and the barriers encountered
5	The views of the current charcoal producers on conditions to accept a switch to sustainable charcoal production
6	Overview of the nature and drivers of unsustainable charcoal production
7	Market research on available improved charcoal production methods/technologies (efficiency, costs, ...)
8	Market research on pricing variables along the value chain, from cost of materials, prices at farm- gate, prices at transportation and final prices at end-markets
9	Assessment of the acceptability of improved charcoal production methods/technologies in Mozambique

10	Overview of potential alternative feedstocks for charcoal production and their relevance for Mozambique
11	Existing legislation related to charcoal production (including legislation related to forest management, charcoal production, land tenure, etc.) and institutional framework
12	The views of relevant government bodies on developing a sustainable charcoal production programme, an indication of their willingness to take part in such a programme and their conditions for potential involvement
13	An assessment of the most feasible option or combination of options for this programme, considering the CDM Meth requirements and regulations as well as the local circumstances for designing the options: 1/ Dedicated plantations for charcoal production, 2/ Switching to improved charcoal production methods or 3/ Making charcoal from biomass waste or invasive species
14	Identification, possibly using spatial analysis techniques including GIS, of geographical areas with high potential for charcoal production based on a systematic criteria including population trends, availability of land, availability of feedstock's, transport outlets, past production practices, ...
15	Existing projects on improved charcoal production or related activities (e.g. plantations for biomass energy, REDD+ activities, ...) in the country/region)
16	Assess level of capacity regarding natural resource management communities
17	Agree and plan upon workshop between stakeholder stat want to participate in the programme in order to formulate a programme of activities and make agreements

Deliverables

Report (including a summary for policy makers)

Outline Programme

Overview of visions, intentions and commitment of sector stakeholders to the programme

List of workshop participants, contact details, and indicative date for the workshop

Research Questions (from the Research Plan)

The charcoal value chain is comprised of five components: forest management, production, transportation, retail and consumption. The main research question for work package 1 will be answered through the following sub-questions:

Legal context and partners:

- What are the main drivers for production and consumption?
- Existing legislation related to charcoal production (including legislation related to forest management, charcoal production, land tenure, etc.) and institutional framework?
- Who provides the charcoal production license?, what is the price and conditions?
- How many licenses are provided? Volume? How much is thus illegal production?
- What are the relevant government bodies on developing a sustainable charcoal production programme? Are there winners and losers?
- What are their experiences, views and willingness to take part in such a programme and their conditions for potential involvement?

- Which activities/building blocks of the Biomass Energy Policy that is under formulation could be supported by this initiative? For which activities/building blocks does the GoM see an opportunity for climate financing?

Forest management:

- Where are the main production areas supplying the main urban areas?
- What type of forest is this and what is forest cover/density? i.e. what volume can this type of forest produce per hectare?
- What is net harvested volume of wood per hectare per year?
- Are there any forest management practices or planning (non-use) period)?
- What are the main drivers and is the nature of unsustainable production?
- Identification, possibly using spatial analysis techniques including GIS, of geographical areas with high potential for charcoal production based on a systematic criteria including population trends, availability of land, availability of feedstocks, transport outlets, past production practices

Production:

- What is the volume produced (fuelwood and charcoal)?
- Who makes the charcoal?
- What methods/technologies are used now? (type, efficiency)
- What are the production figures of conversion fuelwood to charcoal per technology?
- What are potential alternative feedstocks?
- What kind of improved charcoal production technologies are available in Mozambique?
- What kind of methane abatement units (as well as flaring) would be feasible on-site?
- What is the estimated electricity consumption of this new technology on-site?
- What is the estimated fossil fuel consumption of this new technology on-site?
- What are existing projects on improved charcoal production or related activities (plantations for biomass energy, REDD + activities)
- What has been tried before and failed? Why?

Transportation:

- Who are involved (actors)?
- How is it organized?
- What are the costs of transportation?

Retail and consumption:

- Who buys charcoal? (consumer group profiles)
- At what price is the charcoal sold? (also trend analysis and price forecasting)
- What are the pricing variables along the value chain (production, transport, end-market) to define the economics of production?
- Who are involved (actors) and how is the value chain organized? (informal and formal part)
- What are current alternative energy sources in the cities for charcoal? Is ethanol gel from sugarcane already available? Is LPG is an alternative? What is their impact on charcoal demand and thus charcoal prices

Work Package 2: Feasibility study on the CDM potential

Background

Many PoA's in the field of reduction of the use of charcoal by using improved stoves. Also Mozambique is included in many PoA's in this field. The field of reduction of emissions from charcoal production is relatively unexplored, while the potential is high. According to earlier research, the conversion of wood into charcoal is probably the step in the charcoal value chain with the highest potential for reducing GHG emissions." (Sanders et al., 2011). The GHG emissions are the result of three factors:

- An unsustainable supply of biomass in which forests are being depleted for the production of this fuel.
- The use of inefficient technologies to convert wood into charcoal with yields as low as 10% observed in certain countries (10 kg of wood required to produce 1 kg of recovered charcoal)
- The use of specific technologies/processes in which the conversion of wood into charcoal leads to a high level of methane emissions.

An improved charcoal production chain could substantially decrease the wood consumed per tonnes of charcoal and reduce the associated CH₄ emissions.

These opportunities can be divided in two types:

(i) Opportunities related to technology for charcoal making:

- Low CH₄ emitting technologies.
- Efficient conversion of biomass to charcoal which leads to biomass savings.

(ii) Opportunities related to a decrease in non-renewable share of biomass used:

- Production of charcoal from carbon neutral biomass sources:
Production of charcoal from dedicated plantations (wood, bamboo etc.). Production of charcoal briquettes obtained from the carbonization and agglomeration of biomass wastes.

The following UNFCCC registered methodologies concern the charcoal sector:

- AMS-III.K.: Avoidance of methane release from charcoal production (1 project registered)
- AMS-III.BG.: Emission reduction through sustainable charcoal production and consumption (0 projects)
- ACM0021: Reduction of emissions from charcoal production by improved kiln design and/or abatement of methane (0 projects, former methodology AM0041 4 projects registered)

According to Perspectives, initiator of a charcoal production standardized baseline methodology, specific barriers have prevented the implementation of CDM projects which reduce emissions associated with the production of charcoal in Least Developed Countries. These are among others the high transaction costs, complex requirements of project specific data, as well as difficulties to demonstrate additionality under the existing procedures.

Besides the registered methodologies, two methodologies in this sector are under approval, the mentioned Perspectives proposal "Standardized baseline and monitoring methodology for the production of sustainable charcoal and charcoal briquettes" and a new small scale methodology on "Low GHG production of charcoal"

Activities

- Assessment of potential measures for GHG reduction in charcoal sector in Mozambique, based on work package 1
- Assessment of available methodologies for the selected measures
- Calculation of CER potential of the selected measures within the selected methodologies
- Assessment of costs and benefits related to selected measures
- National workshop in Mozambique to discuss the options with stakeholders to:
 - o Assess the willingness of the sector to adopt the selected measures
 - o Assess the scale for implementation of the measures
 - o Assess conditions for the organization of implementation of these measures as input for the action plan (work package 3), regarding Coordinating and Managing Entity (CME), monitoring etc.
- Assessment of overall feasibility of the selected and discussed measures for GHG reduction with respect to technical, organizational and financial feasibility by means of the feasibility report.

The *feasibility* of the PoA for charcoal production in Mozambique depends on a number of factors. Key factors are mainly related to:

The technical and organization possibilities to monitor the GHG-emissions related to charcoal production (in accordance with CDM/PoA requirements) Leakage issues under the CDM/PoA methodology The possibilities to set reliable default values fro emissions, for leakage etc.

Now, in case the methodological problems for CDM/PoA will be such that PoA development is not possible, then it can be considered to develop the programme as a NAMA in Mozambique. Advantages of NAMA development are, for example:

- More flexible monitoring approaches are possible
- Nationally appropriate approaches are possible
- A long time frame can be adopted under NAMA

Deliverables

Feasibility Report (including recommendations on the way forward and a summary for policy makers)

Workshop Report of the workshop and its discussions

List of workshop participants, contact details, workshop programme etc.

Overview of visions, intentions and commitment of sector stakeholders to the programme

Approach Workshop

In work package 1 the first preparations for the workshop haven been done. Here it is

assessed who the relevant stakeholders are, talked to in person or addressed through questionnaires etc and the workshop has been announced.

In Mozambique 'a workshop' typically is one dimensional, meaning experts present their PowerPoint presentation and there is less interaction with the public. Of course there will be a presentation of our findings from work package one and two. But as we mentioned in our vision on the assignment, we feel that it is essential to get through the core and past the surface. With the workshop we want to make use of the opportunity to do so through small thematic working groups and to assess where stakeholders are standing. Not only to assess their vision, but to challenge them during the workshop to interact and jointly formulate solutions and cooperation's. Our job will be to facilitate this process, to register and concretize them. What the goal to formulate a base PoA plan (for work package 3) and to do so in a creative and stimulating way, for example through the concept of world café; participants move from thematic tables to thematic tables and give their ideas and solutions to a problem; resulting in a jointly formulated plan. If choices need to be made, one can do (individual) voting rounds to see where priorities lie and where the most support is (and by whom).

The key to this workshop will be our preparation; meaning that through our assessment in work package 1 we will have a good overview of ideas within the sector and through our CDM potential assessment what the possibilities are within this CDM programme. Our preparation will be to work everything out as concrete possible, meaning in financial terms, in consequences in the pre-conditions etc. avoiding that during the workshop stakeholders will talk in vague notions and ideas.

CEPAGRI has indicated to support us and we propose to organize the workshop with CEPAGRI; where they can complement us with their network and name; in order to give the workshop body and to interest the sector.

Work Package 3: Plan of Action for setting up the PoA/CPA

The PoA is defined as "a voluntary coordinated action by a private or public entity which coordinates and implements any policy/measure or stated goal (i.e. incentive schemes and voluntary programmes), which leads to anthropogenic GHG emission reductions or net anthropogenic greenhouse gas removals by sinks that are additional to any that would occur in the absence of the PoA, via an unlimited number of CDM programme activities (CPAs).

PoAs operate at two levels:

1. The program level, which provides the organizational structure governing the eligibility, operation, monitoring and crediting of individual CPAs included within the PoA.
2. The CPA level, which consists of individual CPAs which are the specific measures through which emissions reductions are generated.

The PoA Design Document (CDM-POA-DD) is the key document involved in the validation and registration of a PoA. It is one of the three documents required for a PoA to be registered.

Our approach will be basically in line with the relevant guidance documents, for example as outlined by the CDM Rulebook. Key steps will be:

- designing/selecting the methodology
- setting the project boundaries
- determining the baseline and additionality
- drafting the PoA design documents
- drafting the CPA design documents
- preparing for validation (DOE, LoA etc.)

Some key issues relevant for the design documents are the following:

the forestry component (project boundaries and sustainability)

the definition of the charcoal production process (and project boundaries, baseline and leakage)

the monitoring of GHG emissions reduction (default values, measured values)

Activities

- Elaboration of the selected most potential measures (technical-, organizational- and financial-wise) from Working Package 2 into a concrete list of required activities
- Discussions with the intended origination for the CME (based on discussions in WP2) on the activities needed to become a well-functioning CME
- Selection of pilot projects (for first CPA's)
- Budgeting of all activities needed and time allocation
- Drafting the Action Plan
- Obtain feedback amongst stakeholders on the Action Plan
- Assessment of financing options for Mozambique with regard to financing of validation and registration activities and PoA activities after registration (CME functioning, monitoring, verification, etc.)
- Report writing and presentation containing at least:
 - o Plan of action
 - o List of stakeholders
 - o Timeline
 - o Budget
 - o Plan for CME organization
 - o Plan for pilot activities (CPA's)
 - o Financial plan

As for a shift to NAMA's is concerned, the same applies as was stated under Work Package 2 (feasibility study). Now, in case the methodological problems for CDM/PoA will be such that PoA development is not possible, then it can be considered to develop the programme as a NAMA in Mozambique. Advantages of NAMA development are, for example:

- More flexible monitoring approaches are possible
- Nationally appropriate approaches are possible
- A long time frame can be adopted under NAMA

Deliverables

Report on the plan of action (including a summary for policy makers)

Overview of visions, intentions and commitment of sector stakeholders to the programme

Work Package 4: Development of the CDM documentation

Background

Work package 4 will basically comprise the preparation and finalization of the CDM documentation, so that validation can be started, submission to UNFCCC and registration of the project can take place. Besides, the additional requirements shall be fulfilled, such as:

- Business plan for the CME and manual (Mozambican authorities)
- Any legal arrangements which are required for securing the rights on the GHG emissions reduction
- Drafting of an ERPA

The output from work Package 4 shall be that the CME is fully prepared for and secured of the realization of the GHG emissions reductions in Mozambique. It means, the CME shall be prepared and equipped on all levels: institutional, technical, methodological and business wise.

An important element of this Work Package is the consultation of stakeholders. As Mozambique is an LDC with strong presence of educated people in Maputo but with lower levels of education and literacy in the other parts of the country, stakeholders consultation shall occur according to appropriate methods, such as:

Publication (in Portuguese) of the PoA in local media, mainly newspapers and relevant websites

Organizing one (or more, if necessary) stakeholders meetings in the countryside with securing the presence of the forestry workers, the charcoal producers and the traders. These meetings shall take place in Portuguese and, if necessary, with translation into local language

Technical meeting with advance producers of charcoal, probably in Maputo
Publication (in English) of the PoA in the international media, including the website of the DOE

Activities

- Discussions with CME on organization and documentation
- Drafting of PoA-DD and CPA-DD
- CDM stakeholder consultation
- Revision of CDM documentation
- Establishing contact with DOE's and requesting offers for validation
- Drafting legal and organizational framework for the CME including ERPA preparations
- Reporting

As for a shift to NAMA's is concerned, the scope of work for the preparation of the documentation will be quite important. Basically, the framework for NAMA documentation is not as strict as it is for CDM/PoA. However, here, we will rely upon similar projects which were developed for setting up NAMA's in other countries.

Deliverables

- Full set of CDM documents (PoA-DD and CPA-DD)
- Offers from DOE's for validation
- Report on organization of the CME including legal arrangements
- Overview of visions, intentions and commitment of sector stakeholders to the programme
- (draft) ERPA

Work Package 5: Securing financing**Background**

Under this work package, the securing of the financing will be developed. Assuming that the activities qualify either for pCDM or for NAMA, the following shall be done:

Applying for (additional) donor financing through securing advance payments. This is common use for agreements between seller and buyer of carbon credits.

Drafting of Terms Sheet (under pCDM or NAMA)

Drafting the ERPA

Contacting potential donors, institutions and/or buyers.

Note 1: at present (February 2013) the state of the CDM market is such that the revenues from a pCDM might be low. Therefore, a careful assessment of the costs and benefits of the pCDM development, its costs for registration and issuance and the cost for monitoring shall be done in the framework of this Work Package.

Note 2: in case the focus of the work will shift towards the development of NAMA, the work under work Package 5 will be directed towards registration under NAMA. It shall be noted, however, that this work shall be based on the appropriate NAMA guideline which will be in force at the time by which work Package 5 will start.

Activities

- Assisting the CME for applying for further financial support with international donors and/or climate funds and investigating the possibilities for micro-credit instruments
- Elaboration on the financing options defined under work Package 3, i.e. contacting international institutions, climate funds and potential buyers
- Further elaboration/modification of the ERPA in view of the potential buyers

Deliverables

- Budget plan for the next steps, including validation, registration and issuance of CERs
- Applications form for additional funding prepared
- ERPA (elaborated) including payment conditions

Annex 2 : Definitions

Biomass is non-fossilized and biodegradable organic material originating from plants, animals and micro-organisms. This shall also include products, by-products, residues and waste from agriculture, forestry and related industries as well as the non-fossilized and biodegradable organic fractions of industrial and municipal wastes. Biomass also includes gases and liquids recovered from the decomposition of non-fossilized and biodegradable organic material.

Briquette. A block of compressed charcoal, coal dust, saw dust, wood chips or any other flammable biomass (agricultural waste). In this study used for fuel or kindling.

Carbonization is the process whereby charcoal is produced through the pyrolysis of woody biomass in charcoal kilns. Through the carbonization, complex carbonaceous substances contained in wood or agricultural residues, mainly cellulose, hemicelluloses and lignin, are broken down by heating into elemental carbon and chemical compounds which may also contain some carbon in their chemical structure. The end products of carbonization under controlled conditions are pyroligneous acid, tar, residual gas and charcoal.

Carbonization cycle. The time needed by a kiln to manufacture charcoal. It is expressed in hours, begins with ignition of the kiln and finishes when the kiln is sealed for cooling.

Charcoal. Charcoal is a solid biofuel obtained from biomass by means of a thermo-chemical process known as "pyrolysis" or "carbonization process", which consists of the thermal decomposition of biomass. Charcoal may be in the form of blocks or can take the form of charcoal briquettes (agglomeration of small carbonized particles or agglomeration of particles that are carbonised).

Existing kiln. A kiln is considered to be existing, if it has been in operation for at least a year prior to the implementation of the project activity. At existing charcoal kilns, the project activity shall avoid or abate methane emissions by the installation of charcoal kilns of enhanced design, and/or by the installation of methane abatement units.

Fuel wood / fire wood. Any wooden material used as fuel for cooking and heating. Typically the wood is collected as logs and branches and used as such.

New kilns. At new kilns constructed to provide capacity additions to existing charcoal kilns, or at Greenfield kilns, the project activity shall mitigate methane emissions by the installation of methane abatement units.

Informal charcoal sector - is characterized by the use of traditional kilns such as earth mound kilns, pit kilns or equivalent open-end technologies, which require no investment besides labour. Individuals or a group of individuals involved in charcoal production, but are not formally registered or formally charged with production and supply of charcoal products or related service by the authorities. Newly established formalized organization by such

individuals, e.g. cooperative, can also be considered as the informal sector for the purpose of this methodology;

Renewable biomass¹⁹ - Biomass is “renewable” if:

1. the biomass is originating from land areas that are **forests, croplands and/or grasslands** under sustainable management
2. the biomass is a **biomass residue**
3. the biomass is the non-fossil fraction of an **industrial or municipal waste**.



¹⁹ Based on EB 23 Report, Annex 18. <http://unfccc.int>

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Annex 4 : Stakeholder List

Stakeholders include policy makers GoM and GoB, NGOs, charcoal cooperatives and local producers, companies, transporters etc.

Country	Organisation	Name/Function	Relevance for this research	Key interview topics	Key observations
Belgium	Min. of Environment	P. Grobben	Focus of the study etc.	GoB involvement	Potential for climate financing
Netherlands	Min. Foreign Affairs	K. Peters	Experience East Africa	Charcoal experience	Charcoal in African energy projects
Netherlands	Min. Foreign Affairs	F. van der Vleuten	Experience East Africa	Charcoal experience	Charcoal in African energy projects
Netherlands	Solidaridad	S. Stehlorst	Pelleting Mozambique	Operations Mozambique	Experience with briquetting project
Germany	GIZ	To be identified	Experience East Africa	Charcoal experience	
Mozambique	Belgium Embassy	C. Aelvoet	Dev. Coop. Mozambique	Operations	Gaza is focal region
Mozambique	FUNAE	J. Cloin	Energy in rural setting	Country experience	Energising rural areas
Mozambique	GIZ	D. van Eijck	Energy in rural setting	Country experience	Potential charcoal projects
Mozambique	Ministry of Environment	M. Mataveia	Government regulations	Government legislation	Ministry of energy recently completed their biomass energy strategy
Mozambique	Ministry of Agriculture	O. Manso	Government regulations	Forestry legislation	
Mozambique	Ministry of Environment	R. Benedito	DNA representative	CDM or NAMA preparedness	CDM authority for Mozambique
Mozambique	Eduardo Mondlane University	M. Falcao	Expert in biomass energy	Biomass baseline	Charcoal project experience
Mozambique	FUNAE	I. Tsamba	Experience with biomass energy projects in Mozambique	Prior experiences and future programs	From Biomass Energy Department
Mozambique	Moz Carbon	M. Cumbane	CDM project developer	Experiences	M. Cumbane is the director of Moz Carbon
Mozambique	SNV	R. Mirra	Biomass energy expert	Baseline, forestry, charcoal production	On Charcoal Producer Associations
UK	Imperial College	R. Martins	PhD on sustainable charcoal production potential in Mozambique	Research observations and data obtained during filed work	Martins has developed a research model to facilitate sustainable charcoal project development

Annex 5 : Options for direct and indirect emission reductions

Actions that lead to direct emission reductions including actions in the investment phase, which are essential / conditional to the successful implementation of the action (operational phase).

<i>Value chain</i>	Direct Emission Reductions	<i>Operational phase</i>	<i>Investment phase</i>	<i>Priority action</i>	<i>Expected results</i>
Biomass production	Sustainable Forest Management	Sustainable Forest Management by communities; Sustainable Forest Management by private sector plantations;	Establishing land rights; Capacity building SFM; Promoting private sector fuelwood plantations with SFM regime;		Re-growth of forests; Neutral wood carbon balance; More community income; Revenues from green charcoal;
	Illegal logging	Communities control forests together with local government; Companies control forests.	Establish effective control system in Exploitation Blocks against illegal logging (feeder road control).		Reduction in illegal logging
	Use of residue	Implementation of opportunity (small, cheaper bag for poor HH)	Find economic opportunity to use charcoal residues (small pieces).		More charcoal is effectively used.
	Fuel switch	Alternative fuel stocks are researched and assessed.			
Production charcoal	Kiln efficiency	Producers use earth kilns more efficiently; Producers switch to cleaner, efficient kilns on fixed locations;	Charcoal Producer Associations are formally established; Training on improving efficiency traditional earth kilns; Training on fixed kiln per block;		Improved GHG balance; More charcoal per kg wood; Less health hazards (smoke); More community income;
	Methane abatement	Methane flaring seems not feasible yet.			Improved GHG balance;
Transporter	Transport by truck	Fuel efficient trucks and more transport by train would enhance performance but do not seem feasible at this stage.			
Wholesale / Retail	Branding and marketing	-			
Consumer	In-efficient use of charcoal	Link to efficient cook stoves projects	No investment		<i>On-going projects</i>

Actions that lead to indirect emission reductions, i.e. support the development of a sustainable charcoal sector and value chains including actions in the investment phase, which are essential / conditional to the successful implementation of the action (operational phase).

Value chain	Indirect Emission Reductions	Operational phase	Investment phase	Priority action?	Expected results
Biomass production	Sustainable Forest Management	Investment in SFM from charcoal tax returns; SFM enforcement; Commercialise the Mopani tree nursery;	Re-define licensing and tax system with % for Community SFM; Training SFM enforcement; Anti-corruption measures; Establish Mopani tree nursery		Re-planting of forests;
	Fuel switch	-			
Production charcoal	Kiln efficiency	Each producer is responsible for its own block and kilns	Fixed kiln per exploitation block per licensed producer		Proper use and maintenance; Re-planting of forests;
	Security of tenure	Each producer has a multi-year license that can be inherited conditional to proper use.	Formalisation and licensing of production;		Investment by producers; Secure income for producers.
	Fire Insurance	All producers become insured against forest fires	Create micro-insurance system against forest fire		Producers are willing to participate and invest;
	Methane abatement	-			
Transporter	Unlicensed transport	Improve enforcement; Re-invest fines in legal production;	Re-invest in forest management		Improve legality
Wholesale / Retail	Branding and marketing	Establishment of a Brand and marketing campaigns targeting urban consumers.	Branding (Type and Origin) and Publicity (also at FACIM fair)		Increased sale of sustainable charcoal;
Consumer	Awareness product	Sale in Maputo and Motola	Branding (Type and Origin) and Publicity (also at FACIM fair)		Increased sale of sustainable charcoal; Incentive to join sustainability scheme by other producers.

Annex 6 : Some projects related to biomass production and use in Mozambique

Type	Title	Status	Source
Efficient cook stoves	Cleanstar Mozambique - Maputo Ethanol Cook stove and Cooking Fuel	Currently selling Ethanol gel from cassave and cook stoves (17.000 users in Maputo)	Interview
Efficient cook stoves	Cleanstar Mozambique - Maputo Ethanol Cook stove and Cooking Fuel Project 1	Submitted to CDM on 05-06-2012, At validation stage	UNEP, June 2013
Efficient cook stoves	MozCarbon	Implementation with a grant from the Energy for Environment Partnership	Interview
Efficient cook stoves	PoA for the reduction of emissions from non-renewable fuel from cooking at household level	Submitted to CDM on 13-12-2011, At validation stage	UNEP, June 2013
Efficient cook stoves	Promoting of Energy Efficient cook stoves within the SADC	Submitted to CDM on 23-03-2012, At validation stage	UNEP, June 2013
Efficient cook stoves	Improved cook stoves program for Malawi and cross-border regions of Mozambique	Submitted to CDM on 01-105-2012, At validation stage	UNEP, June 2013
Efficient cook stoves	SNV together with Municipality of Maputo introduces cook stoves	On-going	Interview
Efficient cook stoves	FUNAE promotes efficient use of biomass (modern kilns) stoves) etc. Took over GIZ-Probes in 2009 and introduces cook stove sin schools, hospitals and households.	On-going	Interview
Efficient cook stoves	FUNAE considers submission of a project proposal under the GIZ ENDEV framework.	Formulation phase	Interview
Forest Management	Envirotrade - Nhamitla forest project in Sofala province at Gorongosa National park	On-going, Supported by CarbonNeutral Company (UK) selling voluntary credits.	Literature and mentioned
Reforestation	HEWA in Cabo Delgado	On-going	Mentioned in interview
Biomass balance	Ministry of Agriculture, DNTF - WISDOM - Woodfuels Integrated Supply-Demand Overview Mapping.	Finalised	Literature
Forest Plantation	Lurio Green Resource – 126,000 ha concession in Nampula	On-going.	Literature
Forest Plantation	Portucel – 173,000 ha concession in Zambezia	On-going	Literature
Forest Plantation	Chikwetl Forests of Niassa	On-going	Literature
Forest Plantation	Florestas de Niassa	On-going	Literature
Forest Plantation	Companhia Florestal de Massangula	On-going	Literature
Forest Plantation	New Forests	On-going	Literature
Forest Plantation	Florestas de Planalto	On-going	Literature

In addition there are various biofuel projects related to Jatropha and sugar cane.

Annex 7: Team and Terms of Reference

The team members are:

Fabienne Heidemann	General project coordinator
Peter de Koning	Senior charcoal sector specialist, Editor charcoal report
Boris Atanassov	Local charcoal/ CDM specialist, co-writer charcoal report
Matsen Jorritsma	CDM/POA specialist
Wim Maaksant	Climate finance specialist
Osvaldo Manso	Local forestry/charcoal specialist and peer reviewer
Federico Vignati	Local sustainability specialist and peer reviewer
Ciska Terblanche	Local CDM/PoA specialist and peer reviewer



Annex 8: Methodology

Technique/ instrument	Description	Applicable
Desk Study	Analysis of primary and secondary data relevant for the scope of the study.	Yes
Direct observations	Observations of sites, practices, living conditions, physical constructions according to a pre-agreed checklist.	Yes
Key informant individual interviews with semi-open questionnaires or checklists	Individual interviews on a number of selected topics according to a pre-agreed checklist. The majority of questions are open-ended and meant to stimulate discussion rather than elicit one-word or one-sentence responses.	Yes
Peer-reviewing	During the study the input and feedback from 3 local experts will be asked on several occasions in order to include the perception of several local stakeholders within their area of expertise.	Yes
Focus groups	Interaction of a group of stakeholder people on a limited set of topics, facilitated by a moderator. Beneficiaries agree on a number of preferences, conclusions, beliefs, attitudes, etc. In this study the input of key stakeholders will be integrated in the assessment during the National Workshop.	Yes
Memory recall	Entails interviews with stakeholders within the value chain, individually or in groups, asking to set out their current situation and to reconstruct their situation in the past according to pre-set topics, such as the impact of deforestation. This info is needed to analyse for example the drivers of change.	Yes
Case studies	In-depth assessment of a very limited number of observations (e.g. such as selection of producers, community development projects). The techniques to be adopted may overlap with those presented above.	Yes
Mini-Survey	A sample of the stakeholders (possible as a control group) is extracted and is asked to answer a short survey. The goal is to cross check findings based on the data from direct research group.	Possible
Photos/images	The consultants will try to underpin results of the data collection with GIS information from satellite pictures of Mozambique. Also, the consultants will take photo's were possible and relevant during field visits in order to support written data.	Possible
Stakeholder consultation	Various stakeholders will be consulted including local charcoal producers. The draft report will be submitted to the Mozambican Ministry of Environment (MICOA) and preferably discussed in the Inter-Ministerial Commission on Biofuels (CIB), led by the Ministry of Energy (ME) and co-ordinated by CEPAGRI from the Ministry of Agriculture.	Possible

Data resources in Mozambique

Besides literature resources, the following types of documents and databases will be consulted as well.

The following databases will be consulted:

1. General internet search
2. Documents held by key consultants and peer-reviewers
3. Documents shared by experts (from universities and research institutions)
4. Documents shared by the different ministries and institutions visited

Data will be collected in the field and through interviews notably:

5. Charcoal Markets and whole-sale yards – Maputo and surrounding production areas
6. Ministries
7. Research institutions and universities
8. Other institutions dealing with biomass energy and forestry.
9. Private sector actors

