SNV

Connecting People's Capacities

Charcoal Value Chain and Improved Cookstove Sector Analyses

SNV Rwanda

positioning document

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ABBREVIATIONS

Belgian Development Agency (BTC)

Biomass Energy Strategy (BEST)

Centre for Innovation and Technology Transfer (CITT)

Charcoal Value Chain (CVC)

Clean Development Mechanism (CDM)

Community –assisted Access to Sustainable Energy (CASE) Project

Global Environment Facility (GEF)

Government of Rwanda (GoR)

Gross Domestic Product (GDP)

Improved Cookstoves (ICS)

Institute of Agriculture and Animal Husbandry (ISAE)

Institute of Scientific and Technological Research (IRST)

International Centre for Soil Fertility and Agriculture Development (IFDC)

Kigali Institute of Science and Technology (KIST)

Lake Victoria Regional Environmental and Sustainable Productivity Programme (RESAPP)

Millennium Village Project (MVP)

Ministry of Agriculture (MINAGRI)

Ministry of Infrastructure (MININFRA)

National Forest Authority (NAFA)

Non-Governmental Organizations (NGO)

Projet d'Appui à la Reforestation au Rwanda (PAREF)

Rwanda Agriculture Research Institute (ISAR)

Rwanda Defense Forces (RDF)

Rwandan Francs (Rwf)

Small and Medium Enterprises (SMEs)

Sustainable Energy Development Project (SEDP)

Sustainable Energy through Woodlots and Agroforestry in the Albertine Rift (SEW) Project

United Nations Framework Convention on Climate Change (UNFCCC)

Value Chain (VC)

1. EXECUTIVE SUMMARY

Rwanda is faced with the serious challenge of using biomass more efficiently. The 2008 wood supply deficit was 61% and in the baseline scenario, with no intervention, the deficit is projected to increase to 78% by 2020. This takes into consideration population projections and the population's preferences for different fuels and different stoves. As urbanization increases, more people will switch to using charcoal. This level of wood supply deficit is not sustainable. Two sectors where there can be a significant amount of progress made in improving biomass usage efficiency are the charcoal value chain (CVC) and the improved cookstoves value chain (ICS VC).

This report serves to provide information about the two sectors relevant to SNV to position itself. It does not intend to provide in-depth and comprehensive sector assessments.

The CVC is a complex chain worth 1.1% – 5% of Rwanda's gross domestic product (GDP) and employs more than 300,000 people, largely on an informal basis. Throughout the CVC, there appear to be many efficiency gaps. In Rwanda, there is already a number of government and non-governmental organization (NGO) CVC related initiatives which are ongoing. However, with careful collaboration, SNV could provide added value to the ongoing initiatives to further assist in improving the CVC efficiency.

With 72% of the urban population relying on charcoal for their cooking and related purposes and an ever growing urban population, the use of improved cookstoves is an important measure to reduce charcoal and subsequently biomass consumption in Rwanda. Although ICS projects have been present in Rwanda since the 1980s and the country boasts a fairly high use of ICS, there is still much inefficiency in the ICS VC, including the lack of understanding about ICS and the lack of use of ICS, even when the stoves are in the population's possession. ICS initiatives are currently being undertaken by the Government of Rwanda (GoR), a limited number of NGOs and, with increasing interest, international private sector organizations with interests in receiving carbon credits from ICS programmes. The current efforts require a longer term perspective to ensure sustainability and this includes further improvement of the coordination between the various efforts, challenges with which SNV could possibly assist.

2. INTRODUCTION

The Charcoal Value Chain (CVC) and Improved Cook Stove (ICS) Sector Analyses were commissioned by SNV in December 2010 in light of SNV wanting to expand its interventions in the renewable energy area. The analyses of the two sectors allow for exploration of the opportunities in the sectors and discover what added value SNV could provide with a value chain intervention. The objective of the analyses is: to complement the existing assessments on CVC and the ICS sector in order to provide SNV with solid background information to make an informed decision on possible engagement in the CVC and/or ICS sector in Rwanda.

3. CHARCOAL VALUE CHAIN

Introduction

The charcoal value chain (CVC) in Rwanda plays a very significant role in the economy - employing, at least part-time, more than 300,000 people and contributing to approximately 1.1% - 5% of Rwanda's GDP[1]. The CVC also plays a significant role in the environmental sector in Rwanda with wood for producing charcoal consuming 23% of the country's energy balance[2]. The importance of the CVC and the need to improve it are recognized in the **2009 Rwanda Energy Policy and Strategy**: *Production of wood for wood fuel and charcoal is recognized as an important rural economic activity and also an environmentally sound one which is to be encouraged by the removal of regulatory restrictions (these will in future only apply to natural woodland); Plantations, woodlots and mixed agro-forestry are to be expanded and better managed (planting and harvesting) on a sustainable basis to support growing wood fuel and charcoal production; Improved technologies for charcoal production and improved stoves to make more efficient use of biomass fuels are supported*.

In order to improve the CVC, it is important that the key stakeholders, their roles, activities, relationships to other stakeholders and effectiveness gaps are clearly defined. Furthermore, it is important to be aware of relevant policies and regulations and possible areas of intervention.

Value chain map

Within the CVC, there are many different stakeholders who participate in the following activities: wood production, carbonization, transportation, retailing and distribution, and consumption. Policies and regulations relevant to each step of the CVC are mentioned throughout the text, highlighted in bold.

The roles, activities and effectiveness gaps of these stakeholders will be detailed below.

Figure 1: Charcoal value chain

Wood production

Within the wood production component of the CVC, there are five key actors: wood producers, local authorities, National Forest Authority (NAFA) District Officer, the financial services provider and research institutions. The key points of the wood production component of the value chain are summarized in Figure 2 below.

[1] Falzon, JP. IS-Academy RENEW. "Creating an enabling business environment for sustainable charcoal chain in Rwanda." 2010.

[2] GTZ/Marge. "Biomass Energy Strategy (BEST), Rwanda. Volume 2: Background & Analysis". 2009.

Stakeholders	Values	Role	Effectiveness gaps
Wood producers	• People: 300,000 •Wood volume: 1,211,538 t •US$ 8.7 million	•Manages /owns plantation •Obtains tree cutting permit • Cut trees (laborers) •Contributes to forest fund •Can use land as a credit guarantee	•Lack of knowledge about forest management leading to minimum investment •No pre-planning possible as there is no certainty about receiving cutting permits •Wood cut when not sufficiently dry •Lack of policy framework and relevant legislation
Local authority		•Decides on when cutting is allowed	•Ban cutting in dry season, when wood is easiest to dry •Lack of consistency on whether cutting will be permitted •Lack of management of public plantations •Lack of long term policy and regulations
NAFA District officer		•Grants tree cutting permit	•Covers too large amount of land which delays permitting •May not be properly trained in forestry
Financial services provider		•Provides financing to purchase land or equipment	•Lack of loans for small and middle enterprises (SMEs)
Research institutes		•Study improved wood production and forest management techniques •Train students in production techniques	• Need to ensure improved techniques are adequately shared with rural wood producers

Figure 2: Summary of wood production section of the CVC

Wood producers

Roles and activities

Wood producers are the largest employed sector in the CVC, employing, at least to some extent, 300,000 people. These stakeholders, and most of the entrepreneurs and workers throughout the CVC, are almost exclusively individuals or small informal enterprises[3]. The wood producers also play the main role in wood production. The producer may own and manage his/her forest, in the case of a private plantation, and have laborers to cut wood or do the cutting his or her self, depending on the size of the forest. Wood producers may also illegally cut wood, in the case of some sector and district plantations. The wood producer is required to request for a permit to cut wood. If the forest is less than 1 ha, the sector official can grant the permit. For cutting of a forest of greater than 1 ha, it is necessary for the District Official from NAFA to grant a permit for the cutting.

The time duration of the permit, between one week and one month, varies by District. The cost of the permit also varies by District. For example, in the Gisagara District, the cost of the permit is 15,000 Rwf plus 1% of the value of the forest to be put into the National Forest Fund. In the Nyamagabe District, the cost of the permit is 10,000 Rwf plus 2,000 Rwf mandatory contribution to the National Forest Fund[4].

Effectiveness gaps

The largest effectiveness gap for wood producers is the lack of management. Wood producers often have very little knowledge about proper forestry management. On average, the productivity of

[3] Falzon, JP. IS-Academy RENEW. "Creating an enabling business environment for sustainable charcoal chain in Rwanda." 2010.

[4] Munyiherwe, Anicet. "CASE Project, Baseline Study Report". 2008.

plantations is 7 m^3/ha/yr[5] while the National Forest Policy envisions increasing productivity to 15 – 30 m^3/ha/yr[6], although achieving and maintaining this rate of productivity may be challenging. Furthermore, there is very little investment put into forests. This may be due to lack of: capital, being able to receive a loan, knowledge about the benefits of investment and/or certainty of future forest policies and legislation. This lack of management is acknowledged in the **Biomass Energy Strategy (BEST)** and the proposed intervention is: *Develop and promote silvicultural practices among private plantation owners, in order to preserve and improve their standing stock, increase the forestry productivity (at least x 2 in managed areas) and favor rational and sustainable tree-cutting; no-one said that this will be easy but better management, fertilizers, more efficient water usage should bring the productivity back in-line with text book conditions for the climatic zone.*

In addition to lack of management of private plantations, there is a need to improve the management of government plantations. Approximately 19% of plantations are owned by Government of Rwanda (GoR) and 80% of those plantations show sign of illegal human intervention such as harvesting. Although harvesting these plantations is currently illegal, with proper management, these plantations could benefit the community as opposed to only a few illegal harvesters[7]. **BEST** acknowledges this intervention as one of its key supply side interventions: *Stop illegal cutting in public plantations, set up management plans for restoring public national and district plantations, develop and promote adapted tree management and rational cutting methods, train local bodies and professionals, in order to have 50% of public plantations under management and rational cutting by 2015 (75% by 2020), with considerably better forestry productivity (x 2 in managed areas); allow private management of public plantations.*

There is also a lack of pre-planning by wood producers. This is in part due to the potentially long and unknown duration of delay for receiving the cutting permit. Wood producers are not able to properly plan the cutting as they do not know when the permit will be received. In addition, this lack of pre-planning sometimes results in the carbonization of wood that has not had sufficient time to dry which reduces the efficiency of carbonization.

Local authority

Roles and activities

In line with the 2000 **Fiscal and Financial Decentralization Policy** (updated in 2006) and the **N 01/2006 Ministerial Order**, regulation of forests was decentralized to a District level. The District decides when cutting permits can be granted. Some Districts ban cutting for weeks or month at a time; the reasoning is often to reduce the risk of forest fires during dry season. In compliance with the **Ministerial Order N 01/2003 prohibiting cutting of immature trees**, trees must be mature prior to granting of a cutting permit.

For plantations less than 1 hectare, first an umudugudu official must give a confirmation that the land belongs to the person applying for the permit. Next, the cell coordinator must grant approval for the cutting. Finally, a sector agronomist must visit the site and provide the permit.

[5] GTZ/Marge. "Biomass Energy Strategy (BEST), Rwanda. Volume 4: Proposed Strategy". 2009.

[6] Ministry of Forestry and Mines (formerly Ministry of Lands, Environment, Forestry, Water and Mines). "National Forestry Policy." 2004.

[7] GTZ/Marge. "Biomass Energy Strategy (BEST), Rwanda. Volume 4: Proposed Strategy". 2009.

For plantations greater than 1 hectare, the same approvals from local authority as required above are also required to receive a cutting permit, in addition to approval by a NAFA District officer.

The local authority receives a portion of the cutting permit fees. In some Districts, taxes are also charged per sack of charcoal produced.

Effectiveness gaps
Districts often ban cutting during dry seasons in order to prevent forest fires. Although this is well intentioned, the bans result in a lower level of charcoal production efficiency as wood carbonizes better when dry. Also, it is presumed that wood producers are careful with forest fires as fires would reduce their income. Cutting can also be banned for a limited duration if other cutting has occurred nearby. Furthermore, the lack of certainty about when cutting will be banned causes wood producers to not be able to pre-plan.

Across districts, there are many variables in the cutting permit process such as: the cutting permit costs and the duration of the validity of the cutting permit. It is also not clear whether the cutting permit time limitation applies to only cutting or cutting and carbonization; at the national level, it is understood that permit is only for cutting but, at the District level, the permit is also often for the carbonization process. Finally, the number of approvals needed from local authority representatives results in delays.

The **2004 Forest Policy** includes objectives to improve the management of forests in Rwanda. However, the Policy is not fully enforced[8]. A draft version of the **new Forest Policy** was released in 2009 and this policy further emphasizes the need to improve management of forests; however, the policy has not yet been finalized. The lack of enforcement of the forest policies by local authorities results in a lack of long term certainty for forest producers; this discourages long term planning.

In addition to the forest policies, Law **N° 04/2005 of 08/04/2005, Organic Law determining the modalities of protection, conservation and promotion of environment in Rwanda**, requires that decentralized entities are responsible for proper management of forests. As stated above, government plantations are not currently being well managed which results in low productivity of the plantations.

NAFA District Officer

Roles and activities
For forests greater than 1 ha, the NAFA District Officer must grant a cutting permit. After receiving the permit request, the Officer must visit all sites to ensure that, among other criteria, the trees have reached full maturity, as required by **Ministerial Order N 01/2003**. As there is only one officer per district who must visit all sites, the time to receive a permit can range from days to months. In early 2010, NAFA plans to install sector officers who are trained in forestry[9]. In most of the country, there will be one officer for every two sectors although for larger sectors there may be one officer per sector. These sector officials will be able to conduct the site visits and then report back to the District Officer who will then have the authority to grant the cutting permit.

Effectiveness gaps
One of the major bottlenecks in the CVC comes from the cutting permit process. Due to lack of capacity, it may take the District Officer weeks or months to visit the site and grant the permit which

[8] Falzon, JP. IS-Academy RENEW. "Creating an enabling business environment for sustainable charcoal chain in Rwanda." 2010.

[9] As told to consultant on 03/01/2011 by Augustin MIHIGO who coordinates cutting permit issues at a national level in NAFA.

hinders the entire CVC. Furthermore, it is not always known by producers upon what basis the permit will be granted or rejected. In addition, District NAFA Officers may not necessarily be foresters but may be trained in other relevant fields which results in capacity issues.

Financial services provider

Roles and activities
Financial services providers provide loans to producers. The loan may be to purchase more land, supplies or equipment. The financial services providers are typically banks or investors but they may also be development organizations who grant loans.

Effectiveness gaps
In Rwanda, there is lack of small and medium enterprises (SMEs) due partially to the lack of provision of loans, and of loans of a reasonable rate with a reasonable payback period, from the financial services providers. However, banks are issuing some loans in relation to the charcoal value chain; it is crucial that the financial service providers become more actively engaged in the CVC as their assistance is essential throughout the chain. Figure 3 below illustrates the integration of financial services providers throughout the CVC.

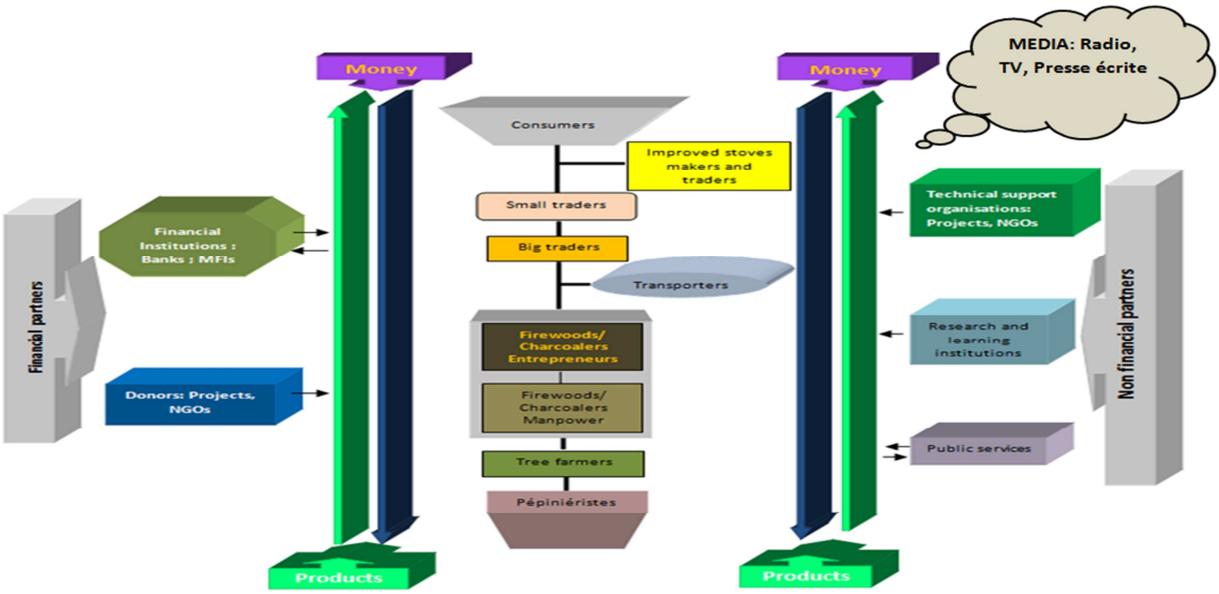

Figure 3: Integration of financial services providers in CVC. Fabien Kayitare. 2010.

Research institutions

Roles and activities

Research institutions, such as the Institute of Scientific and Technological Research (IRST), the Institute of Agriculture and Animal Husbandry (ISAE) and the Rwanda Agriculture Research Institute (ISAR), play an important role in studying improved wood production techniques, such as application of organic fertilizer production, and improved forest management techniques. The research institutes also play a very important role in training students in these techniques.

Effectiveness gaps

Research institutions play an essential role in studying improved techniques. As improved techniques are discovered, it is important that these techniques, and their benefits, are properly conveyed to wood producers.

Carbonization

Within the carbonization section of the CVC, the main stakeholders are charcoal producers, local authorities, middle men, financial services providers, communication enterprises and research institutions. At this stage of the CVC, a bag of charcoal sells for 2,000 – 2,500 Rwf[10], although this price fluctuates depending on the time of year, whether cutting permits are being allowed, the district, etc. The key points of the carbonization section of the CVC are summarized in Figure 4 below.

Carbonization
Sack sale cost: 2,000 – 2,500 Rwf

Stakeholders	Values	Role	Effectiveness gaps
Charcoal producer (owner, foreman, laborer)	• People: 8,000 charcoal producers; 7,000 wood cutters •Annual charcoal volume: 157,000 t •US$ 17.5 million	•Owner: capital for wood purchasing and carbonization •Foreman: organizes and manages team of laborers •Laborer: conducts physical labor in carbonization process	• Use of traditional techniques •Not all producers are in cooperatives •Lack of market information •Lack of charcoal depots •Produce varying quality of charcoal and varying weights of bags •Lack of business skills •Lack of use of tarry residue
Local authority		•Grants tree cutting permit which is also a carbonization permit in some districts •Some districts tax charcoal produced	•Lack of clarity if permit and its time restriction is for only cutting or also for carbonization •Different tax policies
Middle man		•Connects producer and transporter	•Significantly Increases cost
Financial services provider		•Provides financing for supplies or equipment	•Lack of loans for SMEs
Communication enterprises		•Convey information (e.g. market prices) to stakeholders	•Lack of provision of market information to charcoal producers •Lack of awareness about policies and legislations
Research institutes		•Study improved carbonization techniques •Test charcoal (e.g. net calorific value)	•Need to convey information to all stakeholders

Figure 4: Summary of carbonization section of the CVC

[10] Kayitare Fabien. "Firewood and charcoal value chain development" presentation. CARE Rwanda and MININFRA Charcoal Value Chain workshop. 22 December 2010.

Charcoal producers

Roles and activities

There are approximately 8,000 charcoal producers in Rwanda[11], falling into three categories: charcoal owner, charcoal foreman and charcoal workmen[12]. A charcoal owner has the necessary capital to purchase wood, pre-cut, or the right to cut the wood. The charcoal foreman organizes a team of labourers to cut and/or carbonize the wood and oversees the workmen. The workmen carry out the physical labor of the process including: cutting the wood (if applicable), transporting the wood to the kiln, digging the kiln, monitoring the carbonization process, opening the kiln upon completion of carbonization and extracting the charcoal once cooled. Once the charcoal is cooled, it is then packed into bags and brought to a designated area for pick up by transporters. It is often assumed that those involved in charcoal production are often of a very low economic status. However, in a socio-economic study conducted in Western Uganda, this was found to be a false assumption. Charcoal producers have significantly higher total and per adult equivalent incomes than non-producers (152,563 vs. 84,387 Ugandan shillings and 46,117 vs. 27,511 Ugandan shillings[13], respectively)[14]. The socio-economics of charcoal producers in Rwanda is unknown.

Effectiveness gaps

There are many effectiveness gaps in the charcoal production process but one of the most significant is the use of traditional carbonization techniques by the vast majority of charcoal producers; there is a very low penetration level of improved techniques. The traditional techniques have an average efficiency of about 11%, while simple techniques which already exist in Rwanda can increase the efficiency from 20-30%[15]. Another gap is that there is a large variety in quality of charcoal sold on the market; the quality depends on the type of raw material used, how dry the raw material is, the carbonization process, etc. Often, high quality charcoal is placed on top of a bag and low quality charcoal is placed lower in a bag and purchasers of charcoal are not aware of the actual quality of the product they are purchasing. In addition to there being no standard on the quality of material, there is also no standard weight of charcoal bags. Sometimes large bags sold by the producer are then separated into smaller bags and sold onwards for a similar price but with a much smaller quantity. There are no current plans for the Rwanda Bureau of Standards to create a charcoal standard.

Finally, during the carbonization process, a thick black tarry residue is produced. In one study in Rwanda, 10 litres of the tarry residue was produced during the carbonization of 32 stere (one stere is one cubic metre)[16]. Typically, this residue is wasted. However, it can be used to produce paint, shoe polish, insect repellent and, potentially, fuel.

Although some charcoal producers are in co-operatives, there are also many charcoal producers who are not in co-operatives. In addition, the co-operatives which are formed are often not properly connected to necessary stakeholders or recognized sufficiently by public institutions. Co-operatives can help to improve the efficiency of the chain and improve revenue to the producers through

[11] Falzon, JP. IS-Academy RENEW. "Creating an enabling business environment for sustainable charcoal chain in Rwanda." 2010.

[12] GTZ/Marge. "Biomass Energy Strategy (BEST), Rwanda. Field Study Report". 2008.

[13] 1 Ush = 0.258 Rwf as of 28/01/11.

[14] Khundi, Fydess; Jagger, Pamela; Shively, Gerald; Sserunkuuma, Dick. "Income, poverty and charcoal production in Uganda." *Forest Policy and Economics*. 2011 (not yet published).

[15] MININFRA. "Intego z'urwego rw'ingufu mu iterambere ry'igihugu: *Objectives of energy sector in the development of the country*" presentation. CARE Rwanda and MININFRA Charcoal Value Chain workshop. 22 December 2010.

[16] Imbabazi, Berthe. "Internship report carried out in IFDC/Rwanda." 2010.

collaboration and information sharing. One vital piece of information that producers lack is market price knowledge. However, as of December 2010, charcoal will be included in the e-Soko platform which is a virtual platform under the Ministry of Agriculture (MINAGRI) to provide market information to farmers. Charcoal producers will have access to charcoal price information via SMS, call (for producers who cannot read or write), email or internet[17]. Furthermore, co-operatives can organize charcoal depots where charcoal producers can bring their charcoal for transport.

Charcoal producers are also lacking in business skills. Business development skills would allow the producers to better manage their business and market their product.

Local authority

Roles and activities
The local authority has two potential roles in the charcoal production process. Although national legislation mandates that the cutting permit is only for tree cutting, some districts use this permit as a cutting and carbonization permit therefore restricting the time during which carbonization can be completed. Additionally, some districts charge a tax per bag of charcoal produced. When a tax is charged, the sector agronomist visit the charcoal production site to count the number of bags of charcoal produced.

Effectiveness gaps
There appears to be a lack of clarity about whether the permit, and its time restriction, applies to only cutting or to cutting and carbonization. This issue should be clarified and applied uniformly across all districts. Additionally, the taxation rate, if there is to be one, per bag of charcoal should be transparently available to all stakeholders and be uniform across districts. **BEST** acknowledges the taxation issue and recommends the following interventions: *Replace the regulatory and tax system for wood products with a new simplified system by 2010: (a) decentralized but under national guidelines; (b) unique control and tax collection systems at transport level; (c) contribution to districts and national forestry fund; (d) slightly higher tax level in order to cover forestry plantation and/or management costs (estimated to about 5 FRW/kg of wood); and (e) with level around 10% of the product retail prices. Establish a comprehensive efficient system to collect taxes and verify compliance, with the objective to reach a 70% collection rate by 2015 (over 80% in 2020), compared to the present estimated 55%.* However, to date, these interventions have not been implemented.

Middle men

Roles and activities
Middle men are business men who play two roles in the CVC. The first role is to connect producers of charcoal to transporters of charcoal.

Effectiveness gaps
Although the connecting done by middle men is an important part of the chain, it can also cause ineffectiveness in the CVC as the involvement of middle men significantly increases the price of a bag of charcoal. If charcoal producers were organized into co-operatives who communicated well with transporters or who created charcoal depots, the middle men could be eliminated and the price of

[17] The e-Soko website is www.e-soko.rw. However, at the time of the writing of this report, there was no information available on the website.

charcoal would decrease for consumers or producers would receive a larger share of profit from the charcoal.

Financial services providers

Roles and activities
Financial services providers provide loans to producers. The loan may be to purchase supplies or equipment.

Effectiveness gaps
In Rwanda, there is lack of small and medium enterprises (SMEs) due partially to the lack of provision of loans, and of loans of a reasonable rate with a reasonable payback period, from the financial services providers. This issue hinders investment in charcoal production particularly in regards to implementing improved kilns for carbonization.

Communication enterprises

Roles and activities
Communication enterprises play a significant role in conveying information to charcoal producers and middle men via SMS, radio, television or internet. One key piece of information that should be conveyed to all stakeholders is market price. Another piece of information key to the CVC is knowledge of relevant legislation and policies.

Effectiveness gaps
A major gap in this section is proper communication to charcoal producers. Often, middle men know the market price of a bag of charcoal but charcoal producers do not receive this information, and so, sell their charcoal for a price much lower than the market price. The price of a bag of charcoal will soon be available on the e-Soko platform, as mentioned above, but it is crucial that charcoal producers are aware of this source of information and know how to use it properly.

Regarding knowledge of relevant legislation and policies, there is a large gap in this area. Many stakeholders are not aware of relevant policies, such as whether a district is banning charcoal production at that time; better communication to all the stakeholders in charcoal production would improve efficiency and transparency of the process.

Research institutions

Roles and activities
Research institutions, such as the Institute of Scientific and Technological Research (IRST) and the Rwanda Agriculture Research Institute (ISAR), play an important role in studying improved charcoal production techniques and studying the calorific values of different types of charcoal produced.

Effectiveness gaps
As improved charcoal production techniques are discovered, it is important that these techniques, and their benefits, and other information is properly conveyed to charcoal producers and other stakeholders, such as local authorities so that they can use the information in their decision making.

Transportation

The main stakeholders in the transportation section of the charcoal value chain are the transporters, community police and middle men. At this stage of the CVC, a bag of charcoal sells for 3,500 – 4,000 Rwf[18]. The key points of the transportation section of the CVC are summarized in Figure 5.

Stakeholders	Values	Role	Effectiveness gaps
Transporter	• People: 200-300 •Charcoal volume: 157,500 t •US$ 19.7 million	•Transfers charcoal from production site to urban area •Transfer charcoal to 1) middle man 2) market 3) consumer	•Lack of connection between transporter and retailers •No transport co-operatives •Challenges of transport permit •No recovery of charcoal dust
Local authority (Community police)		•Issues transport permits •Collects taxes	•Transport permits are for limited duration and very specific to the truck and driver
Middle man		•Buys charcoal from transporter to sell to retailer in urban areas	•Increases costs significantly

Figure 5: Summary of transportation section of the CVC

Transporters

Roles and activities

Transporters transfer the charcoal from the charcoal producers to the retailers in urban areas. There are approximately 200-300 people involved in transportation[19]. The charcoal is brought to 1) middle men who may then transport it onwards 2) markets or small retailers where it is sold to consumers 3) directly to consumers. The transporters who purchase the charcoal may own the trucks used or they may pay the owner to utilize the trucks. After the 1994 war, the trucking fleet in Rwanda almost disappeared. However, due to the deregulation of the industry, there was a rapid recovery of the fleet. Even though the fleet in Rwanda is a relatively small size, in comparison to other countries, trucking cartels have not formed[20].

[18] Kayitare, Fabien. "Firewood and charcoal value chain development" presentation. CARE Rwanda and MININFRA Charcoal Value Chain workshop. 22 December 2010.

[19] Falzon, JP. IS-Academy RENEW. "Creating an enabling business environment for sustainable charcoal chain in Rwanda." 2010.

[20] Teravaninthorn, Supee and Raballand, Gaël. Africa Infrastructure Country Diagnostic. "Transport prices and costs in Africa: A review of the main international corridors". 2008.

Under the **Presidential Decree No 85/01 Regulating General Traffic Police and Road Traffic**, in order to transport more than three bags of charcoal, transporters are required to have a transport permit for charcoal and specifically for a certain vehicle and driver. The permit is granted for a set time duration. In order to receive a transport permit, a number of requirements must be met; these include presentation of the sector report and tree cutting permit and paying fees ranging from 5,000 – 30,000 Rwf[21]. A contribution, typically of 2,000 Rwf, to the National Forest Fund must also be paid, as well as a tax per bag. The requirements vary by District.

Effectiveness gaps
The first gap in this process is lack of direct connection between transporters and retailers. This lack of connection results in the use of middle men. The formation of transportation co-operatives with good connections could help to alleviate this problem.

Secondly, there are challenges from the transport permit process. Although the delays are not as significant as those in the cutting permit process, there are still delays in the permitting process. There are number of administrative requirements which must be met and number of stakeholders must sign the permit. Depending on the District, the stakeholders may include the Mayor, Director of Infrastructure and Officer in Charge of the Environment.

Additionally, the restrictions of the transport permit cause some issues. These issues include problems with meeting the time restriction, if the charcoal is not ready for transport, and the specificity of the permit – for instance, if a driver is ill or the vehicle is broken, the permit cannot be transferred to another driver or vehicle.

Another effectiveness gap is the lack of recovery of charcoal dust. Up to 20% of charcoal is wasted as dust[22], particularly during the transport process. This dust can be recovered and used to produce a low quality briquette, particularly good for use by institutions. Furthermore, the dust can be utilized in specially designed improved cookstoves.

Community Police

Activities and roles
The community police grant transport permits. Community police also establish check points on the roads. At these check points, the police not only check compliance with the permits but they also check the loading of the vehicle to ensure that it is in compliance with the **Presidential Decree No 85/01 Regulating General Traffic Police and Road Traffic**.

Effectiveness gaps
One of the gaps in this process is the delay in granting the transport permit. However, this delay is kept fairly minimal.

Middle men

Roles and activities
The second role middle men play in the CVC is to connect transporters with retailers of charcoal. In

[21] Falzon, JP. IS-Academy RENEW. "Creating an enabling business environment for sustainable charcoal chain in Rwanda." 2010.

[22] Munyehirwe, A. CARE Rwanda. "Community assisted access to sustainable energy project – stove and charcoal market survey report". 2009.

addition to acting as connectors, middle men also sometimes purchase charcoal and transport it to retailers or consumers directly.

Effectiveness gaps
The involvement of middle men in the CVC significantly increases the price of charcoal. In exchange for their services, middle men significantly mark up the price of the charcoal. If transporters, or transporter co-operatives, were adequately informed about the locations of where there was need for charcoal, middle men could be eliminated from this section of the CVC.

Retail and distribution

The main stakeholders in this section of the CVC are the charcoal retailers, local authorities and landlord. At this stage of the CVC, depending on a variety of factors, a bag of charcoal sells for 5,500 – 8,000 Rwf[23]. The key points of the retail and distribution section of the CVC are summarized in Figure 6.

Stakeholders	Values	Role	Effectiveness gaps
Retailer	• People: 2,000 •Charcoal volume: 157,500 t •US$ 6.5 million	•Purchases the charcoal from middle man or transporter •Sells the charcoal at markets or at small shops	•Lack of direct connections with transporters •No recovery of charcoal dust •Small number of co-operatives •Lack of charcoal storage infrastructure •Strengthening of position of existing co-operatives •Lack of business skills
Local authority		•Collects annual taxes	•Lack of transparency about tax rate
Landlord		•Provides a place to store charcoal	•Retailers could form co-operatives so they could own storage areas and not need a landlord

Figure 6: Summary of retail and distribution section of the CVC

Charcoal retailers

Role and responsibilities
Charcoal retailers sell charcoal to consumers. There are retailers at all of the major markets in urban areas as well as many small retailers which sell out of kiosks. Charcoal is sold by either bag or

[23] Kayitare, Fabien. "Firewood and charcoal value chain development" presentation. CARE Rwanda and MININFRA Charcoal Value Chain workshop. 22 December 2010.

bucket. Retailers typically have a large enough stock of charcoal so that they can sell for 25 days in Kigali (approximately 80 bags) and 2 day to one week in urban areas outside of Kigali (approximately two to ten bags)[24].

Effectiveness gaps
One of the gaps in this section is the lack of connections between transporters and retailers. Additionally, as in the transport process, charcoal dust is not recovered. This charcoal dust could be recovered to make briquettes or utilized in special cookstoves purpose made for charcoal dust.

Additionally, there is a lack of co-operatives of charcoal retailers. There are a number of women's co-operatives, such as the Abahujimbaraga co-operative which operates in the Karugira market in Kicukiro, Kigali but even these co-operatives can be strengthened. For instance, even in markets where the retailers are in co-operatives, there is sometimes no storage area for charcoal bags and the bags and charcoal may get wet in heavy rains. The construction of infrastructure to protect the charcoal would be a useful initiative. In addition, the position co-operatives that do already exist could be strengthened through recognition and involvement by the government and other stakeholders.

Furthermore, retailers lack of business management skills. Improved business skills could lead to better organization, planning and product marketing and promotion.

Local authorities

Role and responsibilities
Local authorities collect an annual tax from charcoal retailers. For example, in the district of Kicukiro in Kigali, taxes for retailers are a flat annual fee of 4,000 Rwf and then monthly fees of 3,000 Rwf per month[25].

Effectiveness gaps

There appears to be a need to further clarify the tax rate collected from charcoal retailers as well as to address the inconsistency of the rate across districts.

Landlords

Roles and activities
Landlords store charcoal for the charcoal retailers.

Effectiveness gaps

Payment to landlords is a cost to retailers which would be unnecessary if retailers formed co-operatives and purchased storage infrastructure.

[24] GTZ/Marge. "Biomass Energy Strategy (BEST), Rwanda. Field Study Report". 2008.

[25] Discussion with Abahujimbaraga co-operative on 14/01/11

Consumption

The main stakeholders to be discussed in the charcoal consumption section of the CVC are the consumers and the Ministry of Infrastructure (MININFRA). There are also a number of other stakeholders working in the consumption section but they will be discussed in the second part of this report on Improved Cookstoves. The key points of the consumption section of the CVC are summarized in Figure 7.

Stakeholders	Values	Responsibility	Effectiveness gaps
Consumer	• People: 72% of urban population •Charcoal volume: 157,500 t •US$ 52.5 million	•Burn charcoal for cooking and water boiling	• Use of inefficient stoves
MINIFRA		•Monitor and evaluate charcoal consumption •Propose interventions and strategies •Implement projects to reduce consumption	•Lack of long term sustainability and consistency of interventions

Figure 7: Summary of consumption section of the CVC

Consumer

Roles and responsibilities

In urban areas, 72% of households rely on charcoal for cooking purposes. Nationally, 8% of the cooking energy in Rwanda comes from charcoal[26]. As there is little need for space heating in Rwanda and electricity used is minimal, the majority of Rwanda's energy usage is for cooking or boiling water. In 2007, 77% of the domestic energy use was used for cooking or similar purposes[27].

Effectiveness gaps

The main effectiveness gap in the consumption of charcoal is the use of inefficient cookstoves. The use of these stoves results in a much higher consumption of charcoal than is sustainable. The 2008 usage of charcoal is 157,500 tonnes per year; 1,209,000 tonnes of wood are necessary in order to produce this amount. One stere of wood yields approximately 1 – 1.4 bags of charcoal. At the current national average rate of $7m^3$/ha/year of wood produced, one ha will yield 7 – 9.8 bags of charcoal. Although charcoal bag weights vary greatly, if one bag of charcoal weighs approximately 45.5kg[28], an estimated 352,097 – 492,936 ha were necessary in order to meet the 2008 demand. If business as usual continues, with no interventions, the projected 2020 charcoal consumption in Rwanda is

[26] GTZ/Marge. "Biomass Energy Strategy (BEST), Rwanda. Volume 2: Background & Analysis". 2009.

[27] GTZ/Marge. "Biomass Energy Strategy (BEST), Rwanda. Volume 2: Background & Analysis". 2009.

[28] Falzon, JP. IS-Academy RENEW. "Creating an enabling business environment for sustainable charcoal chain in Rwanda." 2010.

301,000 tonnes per year. This will require an estimated 675,039 – 945,055 ha of wood, at the current carbonization efficiency. The 2008 wood supply deficit was 61% and in the baseline scenario, with no intervention, the deficit is projected to increase to 78% by 2020[29]. This level of charcoal and wood consumption is not sustainable.

MININFRA

Roles and responsibilities
MININFRA's role in the consumption component of the CVC is to evaluate charcoal usage, propose interventions and strategies and implement projects to reduce consumption. The commissioning of BEST has provided a valuable amount of information on the CVC. MININFRA is also implementing a number of improved cookstove related activities to reduce the consumption of charcoal.

Effectiveness gaps
Although MININFRA has written a number of policies and implemented a number of CVC related projects, long term sustainability and consistency of the interventions appear to require continued attention.

Value chain integration

In order to improve the charcoal value chain, it is recommended that four key steps[30] be taken.

Agree on a vision and strategy for upgrading the charcoal value chain.

This needs to be done with participation from all relevant stakeholders. On 22 December 2010, CARE Rwanda and MININFRA organized a CVC workshop which was an excellent first step in active participation of stakeholders. It is, however, crucial that, at the next meeting, the key stakeholders of NAFA and CAMCO, who did not attend, are present. These meetings should be held on a regular basis, perhaps quarterly. At the next meeting, the vision and strategy can be agreed upon. MININFRA should then make this vision and strategy publicly available.

Analyzing opportunities and constraints

Many of the opportunities and constraints of the CVC are mentioned above. However, these should be shared with relevant stakeholders and input should be provided about other opportunities and constraints. In addition, in light of the **National Gender Policy**, how to improve women's role in the CVC should be considered.

Set operational objectives

Once the opportunities and constraints have been decided upon by all stakeholders, operational objectives should be set. These objectives should detail the macro activities that need to be taken in order to improve the CVC.

[29] GTZ/Marge. "Biomass Energy Strategy (BEST), Rwanda. Volume 4: Proposed Strategy". 2009.

[30] Sepp, Steve on behalf of GTZ. "Analysis of charcoal value chains – general considerations." 2010.

Draft action plans which prescribe certain measure in detail, ensure adequate coordination within and among thematic clusters ("fields of action"), and clearly attribute responsibility to certain stakeholders

This step is crucial to the implementation of the CVC improvements. Each stakeholder in the Rwanda CVC needs to be assigned appropriate duties to be completed within a realistic timeline. A coordinating entity which facilitates the actions should also be assigned. Progress on the actions should be reported at the regular stakeholder meetings.

Taxes, Policies and Regulations

Taxes, polices and regulations relevant to the CVC are mentioned above and summarized in Figure 1. Taxes along the CVC amount to about 7% of the end user price[31].

As detailed in the charcoal value chain mapping, policies and regulations which affect the CVC are:

- Energy Policy and Strategy (2009)
- Biomass Energy Strategy (2009)
- Forestry Policy (2004)
- Forestry Policy (draft 2009)
- Ministerial Order N 01/2003 prohibiting cutting of immature trees (2003)
- Ministerial order N 01/2006 on decentralization of forest management (2006)
- National Fiscal and Economic Decentralization Policy
- N° 04/2005 of 08/04/2005, Organic Law determining the modalities of protection, conservation and promotion of environment in Rwanda
- National Gender Policy
- 02/09/2002- Presidential Decree No 85/01 Regulating general traffic police and road traffic

One key challenge is that although there are many policies and regulations which should increase the efficiency of the charcoal value chain, unfortunately, due to a lack of capacity and funding, many of the policies are not enforced and objectives have not yet been met. As part of the value chain linkage process, it is crucial that the government is involved and actions are taken by all stakeholders to meet the objectives of the policies and regulation. The key taxes and policies and regulations in the CVC are summarized in Figure 8.

Previous and on-going charcoal value chain initiatives

In Rwanda, there are a number of charcoal value chain initiatives ongoing. The Government of Rwanda (GoR) has hired Camco to implement the one year Dissemination of Improved Carbonization Techniques and Reorganization of Charcoal Supply Chain in Rwanda Project. The Global Environment Facility (GEF) Sustainable Energy Development Project (SEDP) will also contain a subcomponent of analyzing and transforming the charcoal value chain, with a focus on charcoal production. There are also a number of NGOs working on the CVC. They include initiatives under taken by CARE Rwanda, IFDC and Vi-Life.

Camco: Dissemination of Improved Carbonization techniques and Reorganization of Charcoal Supply Chain in Rwanda Project/MININFRA (April 2010 – March 2011)

[31] GTZ/Marge. "Biomass Energy Strategy (BEST), Rwanda. Volume 2: Background & Analysis". 2009.

MININFRA contracted Camco to implement a project in the Western Province: 4 Districts (Karongi, Rutsiro, Nyamasheke, Rusizi) with the following objective: To reduce overall demand for wood both by increasing efficiency of conversion techniques whilst also shifting the sourcing of wood from unsustainable to sustainable sources. To achieve this objective, the following activities will be conducted: Completion of scoping study; Development of training manuals (forestry and carbonization techniques); Registration of charcoal associations; Implementation of training and demonstration sites; Promotion and marketing. Activities already completed include construction of demonstration kilns; co-operatives initiated; and trainings held in two districts on carbonization techniques and tree nursery management. The project will aim to ensure long term sustainability through gaining community buy-in of the improved techniques which will be taught. The project focus is on the ground training, not policy issues.

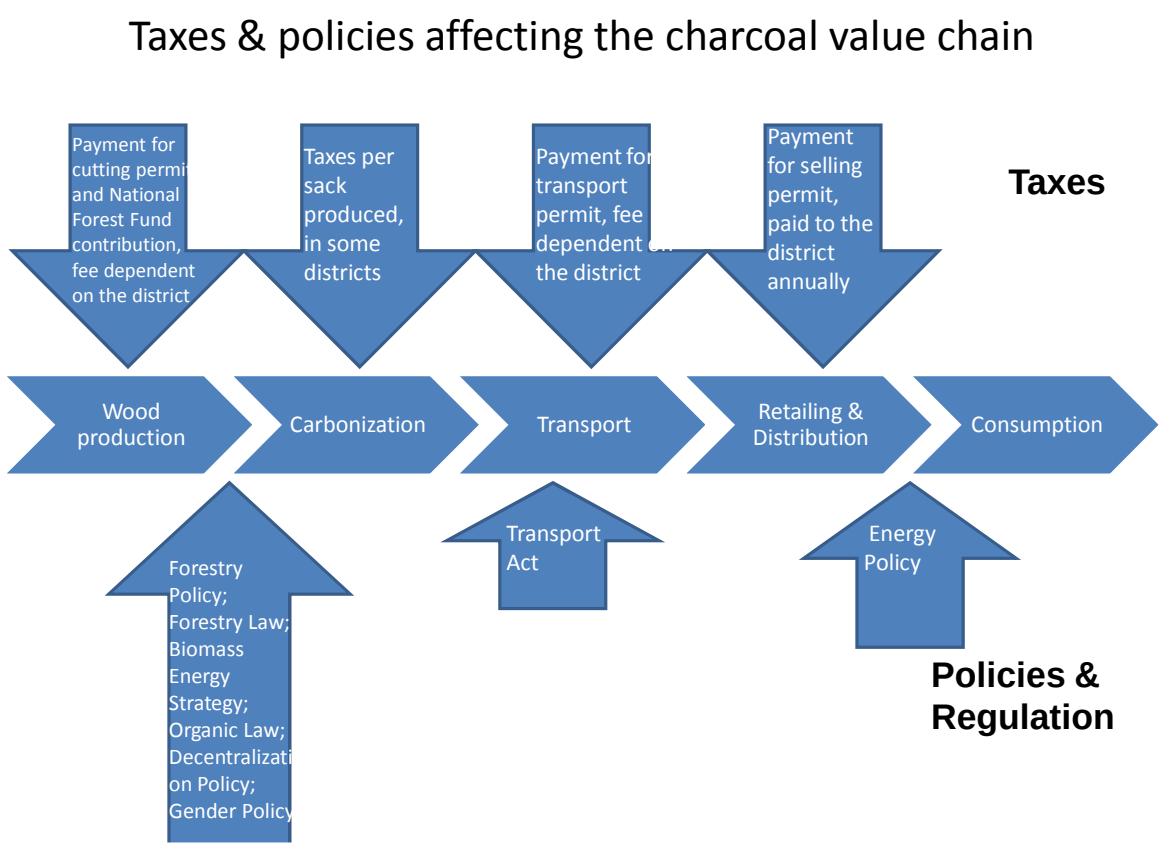

Figure 8: Summary of relevant CVC taxes and policies & regulations

Global Environment Facility Sustainable Energy Development Project (GEF SEDP) (2010-2014)

The SEDP CVC subcomponent will include value chain analysis and transformation, with a focus on charcoal production. The work will be coordinated with the CARE project detailed below. Additional activities will include marketing and awareness raising activities in rural areas, supporting the formation of associations of charcoaling firms and studying required changes in regulatory framework. Project implementation has not yet begun.

CARE Rwanda: Community-assisted Access to Sustainable Energy (CASE) Project (2008-2011)

The CASE project works in the Southern Province in 4 Districts (Huye, Gisagara, Nyamagabe & Nyaruguru). The project objective is: Reduce the gap between biomass energy supply and demand for 24,000 poor rural and peri-urban households by 50% by the year 2010. CARE plans to achieve this objective by undertaking the following activities: Identification and selection of 100 charcoal makers; Train 100 charcoal makers in improved charcoaling techniques; Provide basic tools for charcoal production; Organise the 100 charcoal makers into groups for being later cooperatives; Build charcoal storage facilities for the organised charcoal makers; Conduct a market survey for charcoal and stoves in the Project working areas. Activities already completed include: 110 charcoal makers selected and trained in improved carbonization techniques; basic tools distributed; organization of 110 charcoal makers into co-operatives; 8 charcoal storage facilities under construction; completion of market survey for charcoal and cookstoves.

International Center for Soil Fertility and Agriculture Development (IFDC): Sustainable Energy through Woodlots and Agroforestry in the Albertine Rift (SEW) Project (2009 – 2012)

The SEW project works in the South, West and North Provinces with the objective of: Decreasing competition for land use between energy and agricultural production by improving wood production, use and income from woodlots and agroforestry plantings. IFDC plans to achieve this objective through the completion of the following activities: Facilitating linkage between firewood and CVC actors; Transferring technology transfer and building capacity; Providing seed money through small grants to promote innovation and technology transfer; Providing training business and entrepreneurship development; Researching and learning. Activities completed include trainings on improved carbonization techniques as well as on entrepreneurship, project management and saving and credit. An additional activity conducted includes trainings partners in Market Information Systems (MIS). Stakeholder workshops about the CVC are also held. Finally, IFDC has provided a number of small grants to assist in stakeholder initiatives.

Vi-Life: Lake Victoria Regional Environmental and Sustainable Productivity Programme (RESAPP) (2009 – 2012)

This Vi-Life project works in the North and West Provinces in 5 Districts (Karongi, Rulindo, Byumba, Kaniga, Gasabo). The project objective is: Provide improved living conditions for 250,000 farmer households through sustainable use of natural resources within the Lake Victoria Region by 2012. Activities that will be conducted to meet this objective are: Provide trainings on improved charcoal making techniques, good management of forests (erosion control, tree cutting methods), co-operative formation and management; Strengthen existing and new co-operatives; Facilitate farmers to improve their networks; Increase services on charcoal production and utilization through other actors; Sensitize the population to plant more trees. Improved carbonization techniques, co-operative formation and management and forest management trainings were completed in 3 districts, training a total of 212 producers.

Royal Netherlands Embassy in collaboration with the Belgian Development Agency (BTC): Projet d'Appui à la Reforestation au Rwanda (PAREF) II (2009 - 2012)

The PAREF project works in 9 districts in the North and West provinces. The project aims to build forest management capacity in the government, improve the management of government plantations in the 9 districts and improve plantation productivity and wood use efficiency. PAREF I has been successfully implemented in different areas; PAREF II will continue activities in new locations.

4. IMPROVED COOKSTOVE (ICS) SECTOR

Introduction

Charcoal use in Rwanda is approximately 157,500 tonnes per year with a value of US$ 17.5 million. It is the primary cooking fuel of 72% of Kigali, Rwanda's largest urban area[32]. As urbanization of Rwanda increases, the demand for charcoal is also expected to increase. The **Biomass Energy Strategy** (**BEST)** aims to promote interventions which will increase charcoal usage efficiency and increase the usage of other cooking fuels such as LPG, natural gas and electricity. BEST also suggest the intervention of *Active and aggressive promotion of improved charcoal stoves, in order to nearly eradicate inefficient traditional stoves and reach at least 80% of the urban market by 2015 (86% in 2020) and 50% of the rural market (63% in 2020); 2nd generation improved stoves will be increasingly incorporated*. However, in order to successfully complete this intervention, it is crucial to understand all of the components of the improved cookstove (ICS) value chain (VC), the roles, activities and relationships of stakeholders and their effectiveness gaps, relevant policies and regulation and possible areas for intervention.

The CARE Case Report suggests a marked difference in uptake of improved charcoal stoves between urban and rural areas at least in part of the country, as in a baseline survey conducted in SW Rwanda nearly all rural households surveyed reported to rely on wood for cooking.

Improved cookstove value chain (ICS VC)

The key components of the ICS VC are design, production, retail and distribution and use. The roles, activities and effectiveness gaps of the involved stakeholders will be detailed below.

Figure 9: Improved cook stove value chain summary

Design

The design component of the ICS VC consists of small and medium enterprises (SMEs) (local and international), research institutions, the Ministry of Infrastructure (MININFRA) and financial services providers. The key points of the design section of the ICS VC are summarized in Figure 10.

Roles and activities
Within the SME stakeholders, there are two types of stakeholders, international and local.

Since the 1980s, international non-governmental organizations (NGOs), such as CARE, have worked to introduce ICS into Rwanda. Over the years, following the introduction of ICS design concepts, local

[32] Falzon, JP. IS-Academy RENEW. "Creating an enabling business environment for sustainable charcoal chain in Rwanda." 2010.

SMEs have adapted the designs to local needs and available materials. The adaptation of newly introduced designs has been a continuous process. There are approximately 100 informal SMEs working in cookstove production. Similar to those involved in the CVC, these SMES are almost exclusively individuals or small informal enterprises[33].

Stakeholders	Values	Role	Effectiveness gaps
SME (local and international)	•100 informal businesses (local) • >7 businesses (international)	•Design ICS •Adapt ICS designs	• Lack of coordination •Lack of focal point •Lack of standards for ICS
Research institutions	•>3 institutions (CITT, IRST, Tumba)	•Design of ICS	•Lack of interaction with SMEs
MININFRA / Practical Action		•Coordinating latest ICS design program	•Lack of interaction with international SMEs •Lack of long term coordination
Financial services provider		•Provides financing	•Lack of loans for small and middle enterprises (SMEs)

Figure 10: Summary of design section of ICS VC

Recently, international ICS SMEs, especially those involved in the carbon market, have expressed interest or have begun working in Rwanda. Each of the SMEs has presented a different type of ICS ranging from locally produced ones to second generation imported ICS that will be assembled locally.

Effectiveness gaps
There is little co-ordination of SMEs, either national or international. Different designs are being introduced or being proposed to be introduced throughout the country. There is also a lack of a focal point for ICS. Although there is staff in the Ministry of Infrastructure (MININFRA) working on ICS, this staff is not widely involved in ongoing ICS projects from international SMEs. Furthermore, there is currently no standard for ICS. This results in some ICS of poor quality being designed which hampers customer trust in ICS. However, an ICS standard is being developed by Practical Action, as will be described below.

Research institutions

Roles and activities
There are research institutions in Rwanda working on the design of ICS. Research institutions doing research on ICS include Centre for Innovation and Technology Transfer (CITT) at the Kigali Institute of Science and Technology (KIST), the Institute of Scientific and Technological Research (IRST), the Tumba College of Technology and the Kicukiro Institute of Technology.

[33] Falzon, JP. IS-Academy RENEW. "Creating an enabling business environment for sustainable charcoal chain in Rwanda." 2010.

Effectiveness gaps
Although the research institutions do interact with some stakeholders, most of their work is done internally, with staff or students. There is minimal interaction with national SMEs. Greater information sharing would be beneficial to all parties. Also, greater integration of ICS design into university courses would assist in training future private sector members.

Ministry of Infrastructure

Roles and activities
From mid 2010 – mid 2011, MININFRA has contracted Practical Action, a development NGO and consultant, to implement a rural and an urban ICS project which includes selecting three of the best and most cost effective designs of *canamake*, or the most common type of locally made ICS[34].

Effectiveness gaps
Although Practical Action has been working closely with local SMEs on the design of ICS, Practical Action has had little interaction with the international SMEs interested in working in Rwanda. It would be useful for all parties involved to collaborate on the ICS design. Also, the Practical Action project is only for one year which stresses the importance of longer term coordination of efforts.

Financial services providers

Roles and activities
Financial services providers can provide loans to SMEs so that they are able to purchase equipment to aid in experimenting with different ICS designs.

Effectiveness gaps
In Rwanda, there is lack of small and medium enterprises (SMEs) due partially to the lack of provision of loans, and of loans of a reasonable rate with a reasonable payback period, from the financial services providers.

Production

The key stakeholders in the production component of the ICS VC are the same as those in the design component: SMEs (national and international), research institutions, MININFRA and financial services providers. The key points of the production sector of the ICS VC are summarized in Figure 11.

SMEs

Roles and activities
There are approximately 100 local SMEs working on the production of ICS[35]. There are three main stages of the *canamake,* the most common locally made ICS, production process: metal cladding (exterior portion of the ICS) production which is completed by metal working artisans; ceramic liners

[34] In a survey completed by the consultant in a Kigali neighborhood in October 2010, more than 70% of the ICS found in households were *canamake*.

[35] Falzon, JP. IS-Academy RENEW. "Creating an enabling business environment for sustainable charcoal chain in Rwanda." 2010.

(interior portion of the ICS) which is completed by ceramists; and assembly which is done by the artisans or ceramists.

The international SMEs will employ local SMEs for production of the parts of the ICS and/or for the assembly. Some of the more basic ICS designs which international SMEs plan to introduce into Rwanda will have all components produced in Rwanda. Other ICS designs will require some parts of the ICS to be produced elsewhere and assembled by local SMEs in Rwanda.

Production

Stakeholders	Values	Role	Effectiveness gaps
SME (local and international)	•100 informal businesses (local) •>7 businesses (international)	•Produce ceramic liners •Produce metal cladding •Assemble stoves •Employ local SMEs for production (international)	• Informal sector •Sometimes produce poor quality version of the ICS •Lack of cooperatives •Low purchasing power •High cost of material •Lack of infrastructure for production facilities
Research institutions	•>3 institutions (CITT, IRST, Tumba)	•Produce ICS	•Lack of interaction with SMEs
MININFRA / Practical Action		•Train SMEs in production •Collaborate with Rwanda Bureau of Standards to create an ICS standard	•Lack of interaction with international SMEs •Lack of long term coordination
Financial services provider		•Provides financing for purchase of equipment and infrastructure construction	•Lack of loans for small and middle enterprises (SMEs)

Figure 11: Summary of production section of ICS VC

Effectiveness gaps
Within this component of the ICS CV, there are many effectiveness gaps. The local SMEs are a very informal sector with very few co-operatives and very little coordination. This results in a lack of collaboration and information, such as best practices, sharing. Furthermore, as purchasing is done on a small level, for each SME, there is a low purchasing power and high costs of raw materials. This often results in poor quality materials being used to produce ICS. This use of poor quality material results in the production of poor quality ICS which then damages the reputation of ICS. Furthermore, many SMEs have inadequate infrastructure in which to produce ICS. This means that components may be damaged by rain or the producers may not be able to work in the rain which frequents Rwanda in rainy season.

Due to the informality of the local SMEs, ineffectiveness is caused for international SMEs, as well. International SMEs do not have local focal points to contact to discuss hiring national SMEs for production.

Research institutions

Roles and activities
Some of the research institutions previously mentioned, such as KIST, produce ICS.

Effectiveness gaps
Although CITT does interact with some stakeholders, most of their work is done internally, with KIST staff or students. There is minimal interaction with national SMEs.

MININFRA

Roles and activities
Part of the ICS project being implemented by Practical Action is to train local SMEs in the production of the three selected ICS designs. Furthermore, Practical Action will work with the Rwanda Bureau of Standards to establish standards for ICS.

Effectiveness gaps
MININFRA can further promote the professionalization of ICS producers. The Practical Action project includes training ICS producers to produce ICS to the established standard but it is important that, after the completion of the project, there is continued interaction and follow up with ICS producers to ensure the sustainability of production of high quality ICS.

Financial services providers

Roles and activities
Financial services providers can provide loans to SMEs so that they are able to purchase better equipment for production processes and higher quality raw material and lease or build better infrastructure for production workshops.

Effectiveness gaps
In Rwanda, there is lack of small and medium enterprises (SMEs) due partially to the lack of provision of loans, and of loans of a reasonable rate with a reasonable payback period, from the financial services providers.

Retail and distribution

The key stakeholders in the production component of the ICS VC are: SMEs (national and international), research institutions, MININFRA, consumers and financial services providers. The key points of this section of the ICS VC are summarized in Figure 12.

Stakeholders	Values	Role	Effectiveness gaps
SMEs	•60 informal businesses •>7 businesses (international)	•Purchase ICS from producer •Sell ICSs to consumers	• No marketing and promotion of ICS •Lack of knowledge of benefits of ICS •Lack of being able to recognize low quality ICS
Research institutions		•Sell of ICS, particularly institutional ICS to the GoR	•May hinder SME institutional ICS business
MININFRA / Practical Action		•Marketing and promotion for ICSs	•Lack of long term coordination
Financial services provider		•Provide micro-finance loans to consumers to purchase ICS, particularly 2nd generation ICS	•Lack of low interest micro-financing loans available

Figure 12: Summary of retail and distribution section of ICS VC

SMEs

Roles and activities

SME vendors are the main point of sale of ICS to consumers. They purchase the ICS from the SME producers and then sell ICS to end users. SME vendors may buy from one or more SME producer. The majority of vendors of ICS are located at the major markets of Kigali; there are about 60 vendors selling cookstoves[36]. These vendors pay a tax, which varies by District, to the District authorities in order to be able to sell cookstoves in the market. In order to meet the 80% ICS prevalence rate in Kigali by 2015 which is an objective of GoR as seen in **BEST**, 104,167 ICS will need to be sold in Kigali per year[37].

Efficiency gaps

SME national vendors do not put any resources into marketing ICS[38]. With marketing and promotion, sales of ICS could be increased. Also SME vendors could benefit from further education about ICS and the benefits of their use. They could also be educated about how to recognize low quality ICS and not purchase these from ICS producers.

It remains to be seen what marketing and promotion will be done by international SMEs.

[36] Winrock International prepared for USAID. "Implementation plan for increasing the adoption and use of efficient charcoal cookstoves in urban and peri-urban Kigali". 2007.

[37] Winrock International prepared for USAID. "Implementation plan for increasing the adoption and use of efficient charcoal cookstoves in urban and peri-urban Kigali". 2007.

[38] Winrock International prepared for USAID. "Implementation plan for increasing the adoption and use of efficient charcoal cookstoves in urban and peri-urban Kigali". 2007.

Research institutions

Roles and activities
Research institutions such as CITT sell ICS to institutions and domestic users. CITT has produced marketing material about their ICS and sells to numerous government entities such as the Ministry of Education (MINEDUC) and the national prisons[39].

Effectiveness gaps
With research institutions having direct connections to the GoR and experience in providing services to the GoR, this may hamper private sector development as government institutions may purchase ICS from research institutions instead of not-as-well established private sector companies.

MININFRA

Roles and responsibilities
One component of the Practical Action project is to create marketing and promotional material for ICS.

Effectiveness gaps
This component is a very important part of the success of ICS VC improvement. However, as this project is only for one year, it is crucial that there is pre-planning on how the campaign will be continued once the project has finished.

Consumers

Roles and responsibilities
The consumers purchase ICS and combust charcoal in them. The majority of ICS users are in urban and peri-urban areas while in rural areas, there is a much greater use of wood fuelled 3 stone fires. In Kigali, there is an ICS market penetration of about 40%[40].

Effectiveness gaps
There is a significant lack of awareness of the benefits of ICS and also misunderstanding about the stoves. In a household survey conducted in August 2009[41], 37% of households stated that they had no reason for not using an ICS indicating a lack of awareness about the benefits of the stove. Additionally, the 4 main aspects for disliking ICS were: the stoves use a lot of fuel (27%), they are dangerous (19%), a lot smoke is produced (18%) and the stoves can burn the house (12%). The number one dislike being that the stove uses a lot of fuel demonstrates a clear misunderstanding of the stoves.

Also, it is common knowledge[42] that although many households, especially those in rural areas, have ICS, the stoves are not used for lack of understanding of their benefits. There is no independent evaluation to demonstrate the level of savings or indeed if these stoves are actually even used[43]. If

[39] Information from interview with Rajeev Aggarwal, Director of CITT on 03 January 2011.

[40] Winrock International prepared for USAID. "Implementation plan for increasing the adoption and use of efficient charcoal cookstoves in urban and peri-urban Kigali". 2007.

[41] Green and Clean for MININFRA. "Rwanda Biomass Energy & Stoves Survey". August 2009.

[42] As was discussed by various stakeholders at the CARE Rwanda and MININFRA Charcoal Value Chain workshop on 22 December 2010.

[43] GTZ/Marge. "Biomass Energy Strategy (BEST), Rwanda. Volume 2: Background & Analysis". 2009

households already possess ICS and do not need to pay to purchase them and are still not using them, this clearly demonstrates the lack of knowledge about the benefits.

Furthermore, there is a lack of awareness about micro-finance loans which are often necessary for households to purchase expensive 2nd generation ICS.

Financial services providers

Roles and responsibilities
Financial services providers can provide micro-finance loans to consumers to purchase ICS, particularly 2nd generation ICS which are more costly.

Effectiveness gaps
The lack of micro-finance institutions and the high rate of micro-finance loans contribute to a low application of micro-finance loans for purchase of ICS.

Use

The main stakeholders in the use of ICS are SMEs, MININFRA and consumers. The key points of this section of the ICS VC are summarized in Figure 13.

Roles and responsibilities
SMEs' main role in the use of the ICS is monitoring of the stoves. For national SMEs, monitoring enables SMEs to gauge the market wants and needs and adjust the product as necessary. For most of the international SMEs involved, monitoring of the stove use is a crucial process in acquiring carbon credits. The monitoring results will be made publicly available on the United Nations Framework Convention on Climate Change (UNFCCC) Clean Development Mechanism (CDM) website[44]. This monitoring will be conducted throughout the crediting period of the carbon credit process which is typically 10 – 21 years.

[44] http://cdm.unfccc.int

Stakeholders	Values	Role	Effectiveness gaps
SME		•Monitor ICS use	•No major study on ICS use in Rwanda available
MININFRA / Practical Action		•Monitor ICS projects	•No significant studies completed on results of previous ICS interventions •Lack of long term coordination and therefore lack of long term monitoring and evaluation
Consumer	•72% of urban population of Rwanda	•Use ICS	• Lack of awareness about ICSs •Bad impression of ICSs due to some poor quality ICSs on the market •Lack of use of ICS in possession

Figure 13: Summary of use section of ICS VC

Effectiveness gaps
To date, no major study on the use of ICS in Rwanda has been conducted so there is a lack of data available about ICS use.

MININFRA

Roles and responsibilities
Similar to SMEs, the main role of MININFRA in ICS use is monitoring of the ICS projects being implemented. It is important to monitor the use of the stoves in order to gauge the success of the intervention and improve for the next intervention.

Effectiveness gaps
MININFRA has not yet assessed the results of previous ICS interventions in Rwanda in detail. So there is as of yet insufficient knowledge about the results of the interventions. This results in insufficient application of "lessons learned" from previous work.

The current ICS programme at MININFRA which is being implemented by Practical Action is only a one year programme. It is assumed that upon completion of the programme, some activities initiated will continued to be carried out under the Global Environment Facility (GEF) Sustainable Energy Development Project (SEDP) which will begin implementing activities in 2011. However, the monitoring assessments of the ICS programmes will require further attention.

Consumers

Roles and responsibilities
In 2007, the ICS prevalence in Kigali was 40%[45]. The GoR goal is to reach 80% prevalence by 2015.

[45] Winrock International prepared for USAID. "Implementation plan for increasing the adoption and use of efficient charcoal cookstoves in urban and peri-urban Kigali". 2007.

However, it is crucial that consumers are aware of the benefits of the ICS so that they use the stoves once they have received or purchased them.

Effectiveness gap
Currently, not all consumers use the ICS which they possess. Consumers need to understand the benefits of the ICS and use them in order to reduce charcoal consumption, improve their health and save money. In addition to these benefits, the ICS use is crucial for international SMEs who will be procuring carbon credits as the ICS use will be monitored and verified.

Institutional and policy framework

Currently, there is no regulatory framework directly applicable to the use of improved cookstoves. However, as mentioned in the previous sections, a number of policies are relevant.

- Biomass Energy Strategy
- Energy Policy and Strategy

In addition to the current legislation and policies relevant to ICS, other relevant legislation that could be implemented is in regards to taxation. In **Law N° 21/2006 of 28/04/2006 Establishing the Customs System**, equipment or instruments uniquely used in the conservation or protection of the environment are exempt from import taxes. However, it is not clear if materials for ICS are considered exempt. Additionally, **N° 25/2010 of 28/05/2010 Law modifying and complementing Law n°06/2001 of 20/01/2001 on the code of value added tax lists goods and services excluded from the Value Added Tax (VAT)**. This includes "energy supplies". However, the 5 goods listed under energy supplies do not include materials relevant for ICS. This is particularly relevant for 2nd generation ICS which are much more costly than 1st generation ICS.

Furthermore, there should be a strong emphasis on the **National Gender Policy** which recognizes the importance of increasing women's involvement in environment related activities as well as ensuring that rural households are trained in the use of energy saving stoves and are facilitated in accessing them.

Previous and ongoing ICS initiatives

In the 1980s, CARE trained a Rwandan entrepreneur to develop an improved cookstove under the name *canamake*. CARE was involved for about a year but then the entrepreneur continued to make the stoves[46]. *Canamake* of varying types and qualities are found frequently in Rwanda.

In 1987, World Bank/ Energy Sector Management Assistance Program (ESMAP), with support of GoR, began an ICS project in Rwanda. This project introduced the *rondezera* stove which was a metal bucket shape stove. *Rondezera* are no longer easily found in Rwanda although an adapted model with a ceramic liner is still available.

Promotional and research activities by GoR and the World Bank continued until 1993. In 1994 and 2002, surveys on ICS were conducted by Hall and Mao and the World Bank, respectively.

[46] Winrock International prepared for USAID. "Implementation plan for increasing the adoption and use of efficient charcoal cookstoves in urban and peri-urban Kigali". 2007.

Beginning in 2005, the Rwanda Defense Forces (RDF) began a campaign to disseminate ICS and also to provide training and capacity building on ICS use[47]. However, as mentioned previously, although much of the population has ICS, the ICS are not necessarily utilized by the households.

In May 2006, the GoR announced the objective to implement a massive uptake of ICS. At the end of 2006, in order to assist the GoR in achieving its objective, USAID engaged Winrock International and CITT to conduct a report on the current situation of ICS in Kigali and its surroundings. The report also described the design of an implementation plan. However, this plan was never implemented.

Since 2006, the GoR has supported the dissemination of ICS. In mid-2010, the GoR began one year rural and urban ICS programs that are being implemented by Practical Action. In addition to the Practical Action project, the GEF SEDP will include an ICS component. Finally, a number of NGO charcoal value chain projects include an ICS component. The initiatives are detailed below.

Practical Action/MININFRA Projects (Sept 2010 – Aug 2011)

There are 2 MININFRA ICS projects, one focusing on urban areas and the other on rural areas; Practical Action Consulting was contracted to implement these projects. The projects have seven components: 1) assessment of the overall scenario 2) Assessment of basic data for project implementation (baseline assessment and assessment of performance and quality status of existing ICS) 3) Establishment of selected ICS producers to receive training and to introduction of proper tools 4) Development and implementation of awareness campaign and promotion and marketing strategy 5) Introduction of quality control system for future monitoring (development of ICS quality specifications with the Rwanda Bureau of Standards, equipping of stove producers with appropriate skills and tools and establishing proven quality brand for the stove to be promoted) 6) Introduction of 2nd generation ICS 7) Develop and implement monitoring & evaluation system to monitor the overall project intervention, sales and production figures, quality standards of stoves and impact of the introduced promotion and marketing tools.

Global Environment Facility Sustainable Energy Development Project (GEF SEDP) (2010-2014)

The GEF SEDP will include three relevant ICS activities: 1) ICS promotional campaign 2) feasibility study of households using new generation of cookstoves 3) enhancing private workshop cookstove production.

CARE Rwanda: Community-assisted Access to Sustainable Energy (CASE) Project (2008-2011)

One of the outputs of the CARE CASE project is: 16,000 rural households and 8,000 peri-urban households use improved stoves and save at least one ton of biomass per household per annum. In order to help meet this objective, in 2008, a market survey for charcoal and cookstove use was conducted for the 4 districts where the project works. This survey found that, out of the 813 people interviewed, 48% of them used exclusively improved cookstoves[48]. After the market survey was completed to establish the baseline ICS use, CARE has been conducting ongoing trainings on ICS

[47] Ministry of Defense website. http://www.mod.gov.rw/?COOKING-STOVES-Rondereza-RDF-INPUT. Accessed January 2010.

[48] CARE. "CASE Project Interim Narrative Report/Annual 2008". 2008.

making and workshops to raise awareness about ICS use. Trainings have been provided on square mud and rocket stoves.

Vi-Life: Lake Victoria Regional Environmental and Sustainable Productivity Programme (RESAPP) (2009 – 2012)

The RESAPP project includes an ICS component with a focus on providing trainings on construction of ICS. In 2010, Vi-life trained farmers to construct ICS stoves.

International Center for Soil Fertility and Agriculture Development (IFDC): Sustainable Energy through Woodlots and Agroforestry in the Albertine Rift (SEW) Project (2009 – 2012)

The SEW project includes a component to assist the distribution of 20,000 ICS as well as improve the quality and quantity of ICS produced. IFDC applies a philosophy called "All in One" which consists of linking co-operatives and entrepreneurs who sell wood and charcoal to business people who sell ICS so that the ICS and fuel can be sold alongside each other.

Millennium Village Project (MVP)

The MVP has constructed 5 schools in the Bugesera District. In these schools, institutional ICS were installed and workers were given training on the use of the ICS.

In addition to the afore mentioned government related projects and NGO work, beginning in 2010, there was a significant amount of interested in implementing improved cookstove projects in Rwanda by international SMEs who wish to obtain carbon credits from the emissions reductions under the voluntary carbon market or Clean Development Mechanism (CDM) under the United Nations Framework Convention on Climate Change (UNFCCC). These projects as well as the above mentioned GoR and NGO initiatives are summarized in Table 1.

Project developer	Contact details	Project description	Project stage
Atmosfair	Xaver Kitzinger, Kitzinger@atmosfair.de	Use of Save80 stoves initially in Kigali and then possibly expanding to rural areas	Pre-baseline study completed. Testing of Save80 stove to begin in Dec 2010
Uganda Carbon Bureau	Bill Farmer, billfarmer@ugandacarbon.org	East Africa PoA for all cookstove types	Baseline study in Uganda ongoing, DNAs have been contacted
INYENYERI	Eric Reynolds, ereynolds-boulder@comcast.net	Use of World Stove and construction of biomass pellet factories	Capital raising to begin
Impact Carbon	Matt Evans, mevans@impactcarbon.org	Use of locally (or Ugandan) made efficient charcoal and wood stoves	Scoping visit occurred in Nov 2010
CO2 Balance	Andrew Ocama, andrew.ocama@co2balance.com	Stove type unknown	Initial scoping
Manna Energy	Evan Thomas, evan.thomas@mannaenergy.com	Developed locally made industrial EE cookstoves	Have installed numerous stoves, production facility ongoing, beginning carbon component development
Wonderbag	Sarah Collins sarah@naturalbalancesa.com	Use of Wonderbag cookstove	Scoping visit occurred in Nov 2010 and capital mobilization started
MININFRA/ Practical Action	Hiwote.Teshome@practicalaction.or.ke	1) write policy recommendations for GoR 2) test and select best canamakes 3) train entrepeneurs in production of selected canamakes 4) promotion campaigns for ICS use	Began in Sept 2010 - Aug 2011. Canamakes selected, other components ongoing.
Global Environment Facility Sustainable Energy Development Project (GEF SEDP)	Niyibizi MBANZABIGWI, mbanzabigwi@gmail.com	Continue work from Practical Action. 1) Promotion campaigns to support urban and rural cook stove programs. 2) Introduction and market testing of high efficient stoves 3) Support to professionalization and (semi) industrialisation of stove producers	Dec 2010 - June 2012
Millenium Village Institutional Cookstove Project		Install institutional cookstoves in 5 new schools in Bugesera District	Ongoing since 2009
CARE CASE project	Prudence Ndolimana, prudencen.rw@co.care.org	A 2008 market survey for charcoal and cookstove use was conducted for the 4 districts where the project works. CARE has been conducting ongoing trainings on ICS making and workshops to raise awareness about ICS use.	Ongoing since 2008
Vi-Life RESAPP project	Jean Baptiste Ntahompasze; jbaptistentaho@yahoo.fr	Training population to install ICS	Trainings began in 2009
Sustainable Energy through Woodlots and Agroforestry in the Albertine Rift (SEW)	Fabien KAYITARE, fkayitare@ifdc.org, 0788423055	Assist in distribution of ICS; link fuel and ICS sellers	Ongoing since 2009

Table 1: Ongoing ICS initiatives

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ANNEX 1 PERSONS CONSULTED[49]

Name	Position	Organization
Fabien Kayitare	National value chain expert	IFDC
Prudence Ndolimana	Project Manager	CARE
Fred Smiet	First secretary of regional affairs	Royal Netherlands Embassy
Rajeev Aggarwal	Director CITT	KIST
Hiwote Teshome	Head of Mission	Practical Action/ Ministry of Infrastructure
Abdoul Nkurikiyinka	Project Coordinator	Muyaga Project
Jean Baptiste Ntahompasaze	Sustainable Land Management/Energy Officer	Vi-Life
Emmanuel Ekakoro	Consultant	Camco
Emmanuel Ntuyenabo	Charcoal producer	Self employed
Jean Marie Kayonga	Biomass expert	L'Energie Domestique (Enedom)
Gaspard Nkurikiyumukiza	Head of biomass unit	MININFRA
Gerard Hendricksen	Energy advisor	GIZ/MININFRA

[49] A special thanks to Fabien Kayitare for all of his assistance.

ANNEX 2 EFFECTIVENESS GAPS SUMMARY

Charcoal Value Chain

Stakeholders	Effectiveness gap	Stakeholders	Effectiveness gap	Stakeholders	Effectiveness gap	Stakeholders	Effectiveness gap	Stakeholders	Effectiveness gap
Wood producers	•Lack of knowledge about forest management leading to minimum investment •No pre-planning possible as there is no certainty about receiving cutting permits •Wood cut when not sufficiently dry •Lack of policy framework and relevant legislation •Lack of business skills	Charcoal producer (owner, foreman, laborer)	• Use of traditional techniques •Not all producers are in cooperatives •Lack of market information •Lack of charcoal depots •Produce varying quality of charcoal •Lack of use of tarry residue •Lack of business skills	Transporter	•Lack of connection between transporter and retailers •No transport co-operatives •Challenges of transport permit •No recovery of charcoal dust	Retailer	•Lack of direct connections with transporters •No recovery of charcoal dust •Small number of co-operatives •Lack of charcoal storage infrastructure •Strengthening of position of existing co-operatives	Consumer	• Use of inefficient stoves
Local authority	•Ban cutting in dry season when wood's easiest to dry •Lack of consistency on whether cutting will be permitted •Lack of management of public plantations •Lack of long term policy and regulations	Local authority	•Lack of clarity if permit and its time restriction is for only cutting or also for carbonization •Different tax policies	Local authority (Community police)	•Transport permits are for limited duration and very specific to the truck and driver	Local authority	•Lack of transparency about tax rate	MINIFRA	•Lack of long term sustainability and consistency of interventions
NAFA District officer	•Covers too large amount of land which delays permitting •May not be properly trained in forestry	Middle man	•Significantly Increases cost	Middle man	•Increases costs significantly	Landlord	•Retailers could form co-operatives so they could own storage areas and not need a landlord		

Figure 14: Summary of effectiveness gaps in the Charcoal Value Chain

Improved Cookstove Sector

Stakeholders	Effectiveness gaps			
SME (local and international)	• Lack of coordination •Lack of focal point •Lack of standards for ICS	• Informal sector •Sometimes produce poor quality version of the ICS •Lack of cooperatives •Low purchasing power •High cost of material •Lack of infrastructure for production facilities	• No marketing and promotion of ICS •Lack of knowledge of benefits of ICS •Lack of being able to recognize low quality ICS	•No major study on ICS use in Rwanda available
Research institutions	•Lack of interaction with SMEs	•Lack of interaction with SMEs	•May hinder SME institutional ICS business	•No significant studies completed on results of previous ICS interventions •Lack of long term coordination and therefore lack of long term monitoring and evaluation
MININFRA / Practical Action	•Lack of interaction with international SMEs •Lack of long term coordination	•Lack of interaction with international SMEs •Lack of long term coordination	•Lack of long term coordination	• Lack of awareness about ICSs •Bad impression of ICSs due to some poor quality ICSs on the market •Lack of use of ICS in

Figure 15: Summary of effectiveness gaps in the Improved Cookstove Value Chain

ANNEX 3 TECHNOLOGY DETAILS

Improved carbonization techniques

The main improved carbonization techniques being applied in Rwanda are: Casamançaise kiln, rectangular kiln, and installed brick kiln.

Casamançaise and rectangular kilns can be made at a low cost. The only significant cost involved is the purchase of the two chimneys necessary for the kiln to work efficiently. One chimney costs 20,000 – 50,000 Rwf and lasts 3 – 5 carbonizations[50]. At the moment, chimneys are not readily available on the market; they must be specially requested to be made by iron workers.

Casamançaise (top) and rectangular kilns (bottom).

Photo: Fabien Kayitare

Brick kilns greatly increase efficiency and last much longer than simple kilns. However, the labor and material costs are much higher. One small brick kiln which can be used to produce 25 – 30 bags of charcoal costs 350,000 Rwf to build[51].

Cookstove types

Traditional cookstove
In rural areas of Rwanda, there is widespread use of three stone fires where wood fuel is combusted. Most charcoal in Rwanda is combusted in traditional cookstoves made of all metal. There are two main

[50] Interview with Emmanuel Ntuyenabo, a charcoal producer. 14 January 2011.

[51] Interview with Emmanuel Ekakoro, Camco. 08 February 2011.

models in Rwanda. One, called *imbabura*, is cylindrical in shape with a single wall, a firebox about two inches deep, three metal pot rests, a metal perforated grate, and an approximately 3x5 inch opening with no door along the outer body. The *imbabura* costs approximately 500 Rwf. The other model, called Congolese stove, is "Y-shaped" and features a more open firebox sitting on a rectangular box for catching the charcoal ashes.

Imbabura (left) and Congolese stove (right)

Improved cookstoves

The most commonly used type of improved cookstove found in Kigali is the *canamake*. This stove has four components: 1) metal cladding, 2) ceramic liner, 3) grate, and 4) door for draft control. The *canamake* consumes 33% less charcoal than a traditional all metal stove[52]. In Kigali, a *canamake* costs approximately1,000 – 1,200 Rwf, or 800 Rwf if purchased from the manufacturer.

Canamake

Beginning in the 1980s, the dissemination of an all metal, double walled bucket shaped improved cookstove called a *rondereza* began. However, a 2007 Winrock survey found no evidence of the existence of this stove type being sold at markets in Rwanda. The Winrock survey did find evidence of

[52] Winrock International prepared for USAID. "Implementation plan for increasing the adoption and use of efficient charcoal cookstoves in urban and peri-urban Kigali". 2007.

a metal single walled bucket stove with a ceramic liner inside the firebox being sold but it is not widely available. The *rondereza* was found to use 34% more charcoal than the *canamake*.

In addition to portable cookstoves, there are also installed cookstoves. These are typically made of mud and, in urban areas, are covered in tile.

Installed cookstove in urban area

Another ICS that is available in Rwanda is a rocket stove. Rocket stoves are L shaped stoves which can be made from a variety of materials such as mud or metal. Pots are placed on the vertical top component of the stove and fuel is put in the horizontal lower component of the stove. The efficiency of the rocket stoves used in Rwanda is not readily available.

Rocket stoves produced in CARE training

Photo: Taken from CARE CASE project Interim Narrative Report / Annual 2008

2nd generation improved cookstove

An example of one 2nd generation improved cookstove is the Save80 stove. The Save80 stove uses small pieces of wood, many of which would not be utilized due to their small size, and saves 80% of firewood typically consumed by a traditional 3 stone open fire. 250kg of wood can bring 6 litres of water to a boil. When purchased, the Save80 stove comes with one 8 liter pot, one pan and a WonderBox, a heat retaining device where food, after boiling has begun, can be slow cooked without additional fuel. The cost, for all of the parts and including VAT, will be 50,000 Rwf.

Save 80 stove (left) and a WonderBox (right)

ANNEX 4 ENVIRONMENTAL IMPLICATIONS OF UNSUSTAINABLE LEVELS OF CHARCOAL AND WOODFUEL USE IN RWANDA

The charcoal and wood fuel production and consumption in Rwanda significantly affects the economy and environment of the country. Residential demand for wood, either for use in charcoal production or directly as fuel, is 2.9 Mt[53] per year. The current sustainable supply from plantations is 1.1 Mt of wood per year. This results in a deficit of 1.8 Mt per year of wood that is sustainably harvested[54].

However, with improved forestry management, supply could increase from 1.1 Mt to 1.7 Mt while with improved demand side efficiency, demand could be decreased from 2.9 Mt to 2.47 Mt54. This would result in a significantly decreased deficit of 0.77 Mt. Therefore, improvement in the charcoal and wood value chains – from plantation management and wood production to consumption – could significantly improve environmental conditions in Rwanda.

The current 1.8Mt wood deficit leads to an array of negative environmental implications in Rwanda. These effects include deforestation negatively impacting soil, biodiversity and water quality; stronger climate related threats; negative impacts on wetlands; and greenhouse gases being emitted.

Deforestation

The wood deficit in Rwanda results in significant deforestation which causes many negative environmental implications. These negative implications affect: soil, biodiversity and water quality. Further details are provided below.

Soil

Due to its mountainous topography, soil erosion is a major issue in Rwanda. Agriculture practiced on the slopes of hills and mountains, coupled with deforestation has caused extensive land degradation and soil erosion. About 40 per cent of Rwanda's land is classified by the Food and Agriculture Organization (FAO) as having a very high erosion risk with about 37 per cent requiring soil retention measures before cultivation. Only 23.4 per cent of the country's lands are not prone to erosion[55].

[53] Million metric tonnes

[54] Drigo, Rudi and Nzabanita, Vital. *Spatial analysis of woodfuel production and consumption in Rwanda applying the Woodfuel Integrated Supply/Demand Overview Mapping methodology (WISDOM)*. FAO – Forestry Department – Wood Energy. 2011.

[55] Republic of Rwanda. Remarks by H.E. Paul Kagame, President of the Republic of Rwanda at the Africa Climate Change Forum. Kigali. 2008.

In addition to erosion from deforestation, use of crop residues for fuel also leads to problems with soil. Use of crop residues limits the extent to which the residues can be used to conserve soil moisture and fertility[56].

Deforestation also causes a lack of stability in the soil. As climate related events become more regular, this lack of stability will lead to greater problems associated with flooding. The result of human activities (poor farming practices, deforestation and environmental degradation) has aggravated the impacts of floods on people, agriculture and the physical infrastructure56.

The 2009 Rwanda State of Environment and Outlook highlights the problems associated with deforestation in Gishwati Forest:

*Like in any other tropical forests, Gishwati forests helps maintain soil quality, limit erosion, stabilize hillsides and modulate seasonal flooding. It has also protected down stream water resources from accelerated siltation. The loss of the forest in many areas has resulted in tremendous environmental consequences such as accelerated soil erosion and consequent direct loss of agricultural productivity of the farmers. This ecological function is particularly important to the poorest people who rely on natural resources for their everyday survival. Degradation has also led to more floods in Gishwati and electricity shortage in Cyangugu due to siltation of Sebeya River. The rehabilitation and remediation cost of Gishwati is estimated at US$ 3.6 million. Agricultural loss due to degradation was estimated to be up to RWF 120,000 for the next harvesting season. The overall cost of activities to partly rehabilitate Gishwati is estimated at RWF 2 billion for 5 years*56*.*

Biodiversity

Deforestation results in the loss of flora and fauna and their habitat. The biodiversity level in Rwanda has decreased significantly as deforestation and agricultural activities have increased. Deforestation and conversion of natural habitats to agricultural systems in the last three decades has caused a loss of variability across all of its ecosystems[57]. In addition, the majority of trees in plantations in Rwanda are of one type, eucalyptus. Eucalyptus is the dominant specie, occupying 64% of total plantation areas, except in the Nyamagabe region where there are large plantations of Pinus66.

Water Quality

Soil erosion often results in soil being deposited into water bodies. Most of the soil lost through erosion ends up in the stream network and marshlands[58] . This is evident in the siltation of the various rivers and associated wetlands. Research shows that the Nyabarongo river system carries 51 kg/second of soil at Nyabarongo-Kigali, 44 kg/s at Nyabarongo-Kanzenze and 26 kg/s at Akagera-Rusumo55. This siltation of the water bodies can lead to stimulation of aquatic weeds and algae growth as well as degradation of the habitat of aquatic flora and fauna.

[56] Rwanda Environment Management Authority. *Rwanda State of Environment and Outlook*. United Nations Environment Program (UNEP). 2009.

[57] Chemonics International Inc. *Rwanda Environmental Threats and Opportunities Assessment (ETOA) 2008 Update*.

[58] Musahara, H. *Improving Tenure Security For The Rural Poor Rwanda – Country Case Study*. Legal Empowerment of the Poor (LEP). Food and Agriculture Organisation (FAO) of the United Nations. 2006.

Climate-related threats

Climate-related shocks like drought and flooding are becoming more regular in Rwanda. The northern and western regions (Ruhengeri, Gisenyi, Gikongoro and Byumba) experience abundant rainfall that usually causes erosion, flooding and landslides[59]. These climate related events, particularly flooding and heavy rains which can lead to landslides, will be made worse by continued soil erosion and instability.

Wetlands

Wetlands play an extremely important role in the natural habitat of Rwanda. Main functions of wetlands in Rwanda include agriculture production, hydrological functions, biodiversity reservoirs, peat reserve, mitigation of climate change, leisure and tourism and cultural value. The planting of crops and trees, such as eucalyptus, in wetlands threaten the wetland habitat. The cultivation affects the wetlands chemical, physical and hydrological nature56.

Greenhouse gas emissions

Improving the charcoal and wood fuel value chain will reduce greenhouse gas emissions in multiple ways.

The first area where greenhouse gas emissions will be reduced is in the reduction in deforestation that will occur from utilizing improved carbonization techniques or improved cookstoves. If trees are not cut down, they sequester carbon. Using estimations of carbon sequestration in *Eucalyptus grandis* in South Africa[60], one hectare of Eucalyptus which has an increased annual productivity of 9.6 m^3/ha54 (the current Rwandan average) will sequester approximately 4.2 tonnes of carbon dioxide (tCO_2) at maturity[61]. The WISDOM report estimates that with improved forestry management, supply could increase from 1.1 Mt to 1.7 Mt while, with demand side efficiency improvements, demand could decrease from 2.9 Mt to 2.47 Mt. The weighted average mean annual increment for Eucalyptus in Rwanda is calculated as 6.9 t/ha/yr. The 1.03 Mt of possible savings results in the preservation of approximately 150,000 ha/yr[62] equivalent to about 625,000 tCO_2 sequestered.

The second area of greenhouse gas emissions reductions is the reductions of fossil fuel that would be used if business as usual continues and all forests in Rwanda are depleted. Using a methodology[63] prescribed by the United Nations Framework Convention on Climate Change (UNFCCC), the baseline is stated as: "It is assumed that in the absence of the project activity, the baseline scenario would be the use of fossil fuels for meeting similar thermal energy needs." Under this methodology, a highly efficient wood fuel cookstove, such as the Save80 stove, which replaces an inefficient charcoal stove will reduce emissions by approximately t 2.5 – 3 tCO_2 per stove per year. A simpler energy efficient

[59] Twagiramungu, F. Environmental *Profile of Rwanda*. European Commission, Kigali. 2006.

[60] Christie, SI and Scholes, RJ. *Carbon storage in eucalyptus and pine plantations in South Africa.* Division of Forest Science and Technology, CSIR. 2005.

[61] Please note that these are rough estimations as a number of factors, such as the species of eucalyptus, applied may not reflect the situation in Rwanda.

[62] Calculated based on an averaged mean annual increment value from WISDOM report cited in footnote 2.

[63] Methodology AMS. II G, *Energy efficiency measures in thermal applications of non-renewable biomass*. United Nations Framework Convention on Climate Change (UNFCCC).

charcoal stove that replaces an inefficient charcoal stove would reduce emissions by approximately 0.75 – 1.25 tCO_2**Error! Bookmark not defined.**.

The final area of greenhouse gas emissions reductions comes from reduced transport. If the demand for charcoal and wood fuel is reduced, less transportation will be necessary. Default values for US heavy duty[64] diesel vehicles with uncontrolled emissions technology for fuel economy are 1.8 km/litre with CO_2 emissions of 1320 g/km or 0.00132 tCO_2/km[65]. Most charcoal comes to Kigali from southern regions (Butare and Gikongoro) and, to a lesser extent, from the northern region (Gisenyi-Ruhengeri area)[66]. Gikongoro is approximately 150 km from Kigali resulting in 0.2 tCO_2 saved for truck load.

Carbon market

Clean Development Mechanism and Voluntary Carbon Market

There are a number of opportunities to receive carbon credits for emission reductions from improvements of the charcoal and wood fuel value chains. The main opportunities are in improved forest management and improved cookstove use.

The Voluntary Carbon Market is typically the best option to use for land use, land change and forestry (LULUCF) related carbon market projects. The Clean Development Mechanism[67] (CDM) only allows for afforestation and reforestation project types and only 21 out of 2,871 project registered[68] with the United Nations Framework Convention on Climate Change are forestry projects. The Voluntary Carbon Market has more flexibility in LULUCF project types and monitoring methods allowed. The Verified Carbon Standard[69] (VCS) allows for four project types within the sector Agriculture, Forestry & Other Land Use: Afforestation, Reforestation and Revegetation (ARR); Agricultural Land Management (ALM); Improved Forest Management (IFM); Reducing Emissions from Deforestation and Degradation (REDD). Another applicable standard is Plan Vivo which is exclusively for forestry projects. Plan Vivo allows for four project types: Afforestation and reforestation; Agroforestry; Forest restoration; Avoided deforestation. The standard to be applied would depend on the project being undertaken.

Another opportunity for carbon credits is in improved cookstoves. Improved cookstove projects can be done under the CDM or the Voluntary Carbon Market. Under the CDM, the applicable methodology is AMS. II. G *Energy efficiency measures in thermal applications of non-renewable biomass*. In applying this methodology, a highly efficient wood fuel cookstove, such as the Save80 stove, which replaces an inefficient charcoal stove, will reduce emissions by approximately 2.5 – 3 tCO_2 per stove per year. A simpler energy efficient stove that replaces an inefficient charcoal stove would reduce emissions by approximately 0.75 – 1.25 tCO_2. The same methodology can be applied in the Verified Carbon

[64] Gross vehicle weight ratings of 10 to 40 tons

[65] Intergovernmental Panel on Climate Change (IPCC). *The Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories Reference Manual*. 1996.

[66] GTZ/Marge. "Biomass Energy Strategy (BEST), Rwanda. Volume 2: Background & Analysis". 2009.

[67] http://cdm.unfccc.int

[68] As of 01/03/2011.

[69] http://v-c-s.org

Standard. In addition, improved cookstove projects are eligible under the Gold Standard (GS)[70], which certifies high quality renewable energy and energy efficiency projects. GS can be applied in addition to the CDM or alone as a voluntary standard. If a project is solely in the voluntary market, a GS specific methodology, *Indicative Programme, Baseline, and Monitoring Methodology for Improved Cook-Stoves and Kitchen Regimes*, can be applied. This methodology is simpler to apply than AMS. II. G.

If less fuel is used in cooking, emissions reductions will occur from the reduction of fuel combusted to transport the wood or charcoal. However, this will be a small amount of emissions reductions and will not be significant enough to utilize the carbon market as costs would outweigh benefits.

[70] http://cdmgoldstandard.org

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