

**Baseline report**  
**CDM PoA in Kenya**

for  
co2balance Ltd.

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## 1. Introduction

Co2balance Ltd is developing a project that involves the free distribution of efficient wood stoves to households in Kenya. In the absence of this project householders would cook primarily using traditional inefficient 3 stone fires.

Co2balance is going to register this project as a CDM Programme of Activities project using the methodology “AMS – II.G: Energy efficiency measures in thermal applications of non – renewable biomass version 02”.

In line of the General Guidelines for sampling and surveys for small scale CDM project activities published by the EB in their 50th meeting, a sampling plan document has been created to be followed in order to determine parameters values to be included in the PoA. This previous document has set out the process to collect the necessary data to calculate the GHG emission reduction of the project. The third independent party (Germán García Ibáñez) has checked the quality and consistency of the data sent by the co2balance however the data collection field work has been performed by co2balance and no field visits has been done by the third independent party.

The following presents the results of the data collection process.

## 2. Methods and approach

A previous desk study has been carried in order to identify geographic, climate and socio-economic conditions between the different areas to ascertain what factors can influence emissions reductions. The results of the study have been used to divide the target area in different clusters and to identify the sample frame. Four different cluster or areas has been identified (see Appendix 1).

Co2balance is developing 4 Gold Standard projects in Kisumu (cluster 4), Shimba Hills, Likoni and Shimoni (cluster 2). The data collected for these 4 projects will be used for the baseline development of these 2 clusters as the approach used to collect the data (Kitchen Performance Test) can be used in the CDM methodology AMS – II.G.

Therefore only data collection for cluster 1 and 3 is needed, for this purpose the sample frame has been divided firstly by target districts or areas within a cluster, then by villages or sub-areas. A randomly selection of one district for each cluster has been made in the following way, for each district a number has been assigned and a random selection of a unit between the districts numbers has been made.

Thereafter a randomly selection of the villages or sub-areas within the selected districts has been also made in the same way, giving a number to each area and selecting randomly one unit. The results of this random selection are the following:

- Cluster 1:
  - District to be surveyed: Thika
  - Village within the district: Ruiru
- Cluster 3:
  - District to be surveyed: Tana River
  - Village within the district: Banks of the Tana River

#### **Cluster 1:**

The interviewers have carried out the survey in randomly selected households that meets the co2balance stove beneficiary criteria within the sample units. To achieve this goal, villages chiefs have been asked to select 100 households at random according to the beneficiaries' criteria set by co2balance. The surveyed was carried out by the co2balance team in Ruiru village in March 2010.

Baseline cooking fuel consumption has been measured and also demographic, cooking habits and socio-economic characteristics of the target areas. Kitchen survey has been carried out by trained local people leaded by the co2balance Kenyan team, all the test have taken place in kitchens with traditional stoves. Participants has been asked to show the amount of fuel wood used on a normal day with the traditional stove, this amount has been weighed using a spring balance.

#### **Cluster 2:**

363 Kitchen Surveys were administered in households within cluster 2 during February and March 2010. The breakdown of the KS by villages is shown below:

- 73 surveys in Maungu
- 75 surveys in Kasigau
- 30 Muhaka
- 100 Likoni
- 85 Shimoni

The KS survey households were chosen from rocket stoves beneficiaries' record using simple random sampling inside of each of the 5 villages where rocket stoves have been built.

Kitchen Performance Test (KPT) was performed in 120 households<sup>1</sup> in Maungu, Kasigau, Likoni and Shimoni by a field team in February and March 2010. The KPT was conducted over three full days, requiring daily household visits for four days, firewood was weighed daily using a large scale spring scale with 0.1 – 0.5 kg accuracy. The survey was also administered daily to record information about the number of people cooked for. The households for the KPT on the three stone stove users were performed on households with similar socioeconomic and demographic characteristics as the rocket stove beneficiaries but who did not have rocket stoves so as to be representative of the typical efficient stove beneficiary.

The breakdown of the 120 KPT households by village is shown below:

- 20 three stone stove users in Maungu
- 20 three stone stove users in Kasigau
- 40 three stone stove users in Likoni
- 40 three stone stove users in Shimoni

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<sup>1</sup> In total the KPT was performed in 240 households, 120 rocket stove users and 120 three stone stove users. For the CDM baseline development, only the data from the three stone stove users is needed.

**Cluster 3:**

The interviewers have carried out the survey in randomly selected households that meets the co2balance stove beneficiary criteria within the sample units. To achieve this goal, villages chiefs have been asked to select 100 households at random according to the beneficiaries' criteria set by co2balance. The surveyed was carried out by the co2balance team in Umoja village in Tana River in April 2010.

Baseline cooking fuel consumption has been measured and also demographic, cooking habits and socio-economic characteristics of the target areas. Kitchen survey has been carried out by trained local people leaded by the co2balance Kenyan team, all the test have taken place in kitchens with traditional stoves. Participants has been asked to show the amount of fuel wood used on a normal day with the traditional stove, this amount has been weighed using a spring balance.

**Cluster 4:**

128 Kitchen Surveys were administered in households within Kisumu during February and March 2010. The KS survey households were chosen from rocket stoves beneficiaries' record using simple random sampling inside of Kisumu where rocket stoves have been built.

Kitchen Performance Test (KPT) was performed in 40 households<sup>2</sup> by a field team in February and March 2010. The KPT was conducted over three full days, requiring daily household visits for four days, firewood were weighed daily using a large scale spring scale with 0.1 – 0.5 kg accuracy. The survey was also administered daily to record information about the number of people cooked for. The households for the KPT on the three stone stove users were performed on households with similar

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<sup>2</sup> In total the KPT was performed in 80 households, 40 rocket stove users and 40 three stone stove users. For the CDM baseline development, only the data from the three stone stove users is needed.

socioeconomic and demographic characteristics as the rocket stoves beneficiaries but who did not have rocket stoves so as to be representative of the typical efficient stove beneficiary

### **3. Results**

#### **Cluster 1**

The kitchen survey revealed an average family size of 5 and the average number of children in each household came out to be 1.8. The data also showed that there was an illiterate population of 8% in overall sampled population, the percentage of population with primary education come out to be 56%. The data on the status of occupation for the surveyed households revealed that casual labourer constitutes as the prime occupation of 38% of the sample households. Likewise, farming and trade were 29% and 24%.

The survey also presents the details about the energy resource uses by the surveyed households. Burning firewood on a three stone stove was the prime source of energy for majority of households cooking needs. However it was found that 56% of the interviewers were using also charcoal for cooking needs and 15% paraffin. The data obtained from the household survey showed that the 78% of households buy the firewood needed for cooking purpose. The rest collect the firewood spending an average of 1h 30' per day.

The kitchen survey also revealed different fuel consumption in dry and rainy seasons. Average firewood consumption during the dry season came out to be 14.66 kg per day per household and during the rainy season 16.98 kg per day per household, notes that the kitchen survey was held during the dry season.

The firewood consumption is used to determine emission reduction, as per methodology AMS-II.G, the project participants shall make all reasonable efforts to achieve a 90/10 precision (90% confidence interval and 10% margin of error). The minimum sample size with a 90/10 precision results to 15 households and the survey has been performed in 89 households.

Even if the methodology AMS-II.G permits to use average fuel consumption, in order to be conservative the lower bound of a 90% confidence interval of the dry season firewood consumption was chosen to calculate the baseline GHG emissions.

## Cluster 2

The kitchen survey revealed an average family size of 5.4 in Muhaka, 4.2 in Maungu, 4.9 in Kasigau and 5.8 in Likoni and Shimoni. The data also showed that there was an illiterate population of 21% in overall sampled population, the percentage of population with primary education come out to be 51%. The data on the status of occupation for the surveyed households revealed that farming constitutes the prime source of income of the sample households in Maungu and Kasigau, trade in Likoni and Shimoni and casual labourer were the first source of income in Muhaka.

The survey also presents the details about the energy resource uses by the surveyed households. Burning firewood on a three stone stove was the only source of energy for majority of households cooking needs. The data obtained from the household survey showed that the 66.4% of households collect the firewood needed for cooking purpose. The average distance and time spent every day to collect the firewood is showed below:

	Firewood collection	
	Average time spent to collect firewood per day	Average distance to collect firewood (km per day)
<b>Maungu</b>	1h	1.33
<b>Kasigau</b>	1h 30'	1.97
<b>Likoni</b>	1h 20'	1.8
<b>Muhaka</b>	1h 30'	1.67
<b>Shimoni</b>	4h	2.3

**Table 1: Distance and time to collect firewood**

Among the 5 villages, the kitchen performance test revealed average firewood consumption of 11.93 kg per day per household and no difference between rainy and dry season.



The firewood consumption is used to determine emission reduction, as per methodology AMS-II.G, the project participants shall make all reasonable efforts to achieve a 90/10 precision (90% confidence interval and 10% margin of error). The minimum sample size with a 90/10 precision results to 26 households and the survey has been performed in 85 households<sup>3</sup>.

Even if the methodology AMS-II.G permits to use average fuel consumption, in order to be conservative the lower bound of a 90% confidence interval of the firewood consumption was chosen to calculate the baseline GHG emissions.

### **Cluster 3**

The kitchen survey revealed an average family size of 6 and the average number of children in each household came out to be 2.5. The data also showed that there was an illiterate population of 6% in overall sampled population, the percentage of population with primary education come out to be 59%. The data on the status of occupation for the surveyed households revealed that casual labourer constitutes as the prime occupation of 54% of the sample households. Likewise, farming and trade were 31% and 12 %.

The survey also presents the details about the energy resource uses by the surveyed households. Burning firewood on a three stone stove was the prime source of energy for majority of households cooking needs. However it was found that 51% of the interviewers were found using also charcoal for cooking needs and 7% paraffin. Among 100 households survey, 44 households were found to use the three stone stove 2 times per day and 43 were found to use 3 times per day the three stone stove during the dry season. However, during the wet season only 24 were found to use 3 times a day the traditional cook stove and 59 were found to use it 2 times per day. The survey revealed that the interviewers use also charcoal during the wet season.

The data obtained from the household survey showed that the 44% of households buy the firewood needed for cooking purpose. The rest collect the firewood spending an average of 4h per day.

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<sup>3</sup> Despite the fact that the survey team asked the household size before perform the KPT, during the test day there were several households that were cooking for more than the number of people established, to avoid outliers this cases were deleted from calculations.

The kitchen survey also revealed different fuel consumption in dry and rainy seasons, however firewood consumption data measured from the kitchen survey came out to have a high variability and that not achieve the specific level of confidence / precision set out in the methodology AMS. II.G (90/10).

To reach the specific level of confidence / precision, a Kitchen Performance Test (KPT) was performed in 40 households<sup>4</sup> by a field team in April 2010 during wet conditions. The household size and the energy source of energy data from the previous kitchen survey was used to create criteria for the KPT household selection process. In order to cover the typical range of people living in the household and to avoid outliers, households cooking for very large numbers or households with very large number of people living in it (higher than 7), were excluded from the KPT. Also households with 4 or less people were excluded from the KPT selection. In the same manner, only households using charcoal as a secondary fuel were chosen.

The KPT was conducted over three full days, requiring daily households visits for four days, firewood were weighed daily using a large scale spring scale with 0.1 – 0.5 kg accuracy. The survey was also administered daily to record information about the number of people cooked for.

The firewood consumption is used to determine emission reduction, as per methodology AMS-II.G, the project participants shall make all reasonable efforts to achieve a 90/10 precision (90% confidence interval and 10% margin of error). The minimum sample size with a 90/10 precision results to 20 households and the survey has been performed in 31 households<sup>5</sup>.

Even if the methodology AMS-II.G permits to use average fuel consumption, in order to be conservative the lower bound of a 90% confidence interval of the wet season firewood consumption was chosen to calculate the baseline GHG emissions.

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<sup>4</sup> Three stone stove users

<sup>5</sup> Despite the fact that the survey team asked the household size before perform the KPT, during the test day there were several households that were cooking for more than the number of people established, to avoid outliers this cases were deleted from calculations.

#### **Cluster 4**

The kitchen survey revealed an average family size of 5.3 and the average number of children in each household came out to be 2.2. The data also showed that there was an illiterate population of 10% in overall sampled population, the percentage of population with primary education come out to be 77%. The data on the status of occupation for the surveyed households revealed that farming constitutes as the prime occupation of 55% of the sample households, likewise, trade were 27%.

The survey also presents the details about the energy resource uses by the surveyed households. Burning firewood on a three stone stove was the only source of energy for majority of households cooking needs. The data obtained from the household survey showed that the 66% of households buy the firewood needed for cooking purpose. The rest collect the firewood spending an average of 4h 30' per day.

The kitchen performance test revealed average firewood consumption of 11.59 kg per day per household and no difference between rainy and dry season.

The firewood consumption is used to determine emission reduction, as per methodology AMS-II.G, the project participants shall make all reasonable efforts to achieve a 90/10 precision (90% confidence interval and 10% margin of error). The minimum sample size with a 90/10 precision results to 12 households and the survey has been performed in 37 households<sup>6</sup>.

Even if the methodology AMS-II.G permits to use average fuel consumption, in order to be conservative the lower bound of a 90% confidence interval of the firewood consumption was chosen to calculate the baseline GHG emissions.

## Results compilation

Results for the four clusters are presented below:

Firewood use in a 3 stone stove	Number of households *	Mean (kg / HH day)	Std. Deviation	Std. Error Mean	CV	Min sample size (90/10)	Lower bound 90% CI (kg / HH day)
<b>Cluster 1</b>	89	14.66	3.49	0.35	24%	15	14.09
<b>Cluster 2</b>	85	11.93	3.72	0.40	31%	26	11.26
<b>Cluster 3</b>	31	5.76	1.56	0.28	27%	20	5.29
<b>Cluster 4</b>	37	11.59	2.46	0.40	21%	12	10.91

\* Only households that meet the size criteria

**Table 2: Results compilation**

<sup>6</sup> Despite the fact that the survey team asked the household size before perform the KPT, during the test day there were several households that were cooking for more than the number of people established, to avoid outliers this cases were deleted from calculations.

## Appendix 1: Cluster division

Province	Sub cluster (Districts)	Target villages	Climate conditions	Geographical conditions	Total population*	Total urban population*	Population Density*	Rural poverty (%)*	Comments
Eastern	Meru Central	Timau and surrounding areas	Good rainfall	High lands	498.880	53.266	167	43	Cluster 1
		Miringa and surrounding areas							
	North Meru	Maua	Good rainfall	High lands	604.050	11.902	153	53	
		Nyambene							
	Meru South	Not identified	Good rainfall	High lands	205.451	9.248	188	59	
Embu	Embu towns surrounding areas	Good rainfall	High lands	278.196	33.066	382	57		
Coast	Kwale	Shimba Hills	Humid and tropical	Coast	496.133	66.291	60	63	Cluster 2
		Gazi							
	Kilifi	Kaloleni	Humid and tropical	Coast	554.303	69.647	144	72	
		Kilifi town surroundings							
	Malindi	Malindi	Humid and tropical	Coast	281.552	57.695	36	65	
		Watamu							
	Sokoke								
Tana River	Banks of the River Tana	Dry and arid	Low lands - Coast	180.901	14.268	5		Cluster 3	
Central	Nyeri	Aberdares National Park	Good rainfall	High lands	533.696	10.047	197	30	Cluster 1
		Nyeri							
		Mweiga							
		Karatina							
	Thika	Ruiru	Good rainfall	High lands	645.713	168.374	329	35	
		Thika							
	Kiambu	Kiambu	Good rainfall	High lands	335.006	168.374	562	22	
		Lumura							
	Kikuyu								
Rift Valley	Baringo	Kabarnet	Arid	High lands/Middle lands	264.978	16.031	31	46	Cluster 3
		Kabartonjo							
	Kericho	Kericho surrounding areas	Good rainfall	High lands	468.493	38.684	222	49	Cluster 4
	Nandi	Nandi Hills	Good rainfall	High lands	450.787	3.156	200	50	
		Kapsabet							
	Kakamega	Surrounding areas to the national park	Humid and tropical	Middle lands	603.422	58.832	433	63	
	Kisumu	The whole district	Humid and tropical	Middle lands	504.359	194.390	549	63	
	Nakuru	Molo	Semi arid	High lands/Middle lands	1.187.039	353.007	164	39	Cluster 1
		Nakuru							
		Lake Naivasha surrounding areas							
Uasin Gishu		Wareng	Temperate	High Lands	622.705	185.467	187	43	
	Eldoret								

\*From official 1999 Kenyan census