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**MONITORING REPORT**  
**BIOGAS TANKS IN GUIZHOU PROVINCE IN**  
**CHINA**  
**GS 614**



*First Crediting Year*

*1<sup>st</sup> April 2008 to 31<sup>st</sup> March 2009*

## ***Abstract***

This is the first monitoring report for the project GS 614 “Biogas Tank in Guizhou Province, China”. There are two climatic zones in the project area and two monitoring surveys are conducted per year (one during summer and one during winter).

The baseline and the project situation have been surveyed to monitor not only the Green House Gas emissions of the targeted households but also their expenses in fuel purchase and the share of biogas in the total energy requirement of the households.

A couple of difficulties were experienced by the team that made the initial baseline survey, which are explained in a transparent way in this report.

It appears that 930 metric tons of CO<sub>2</sub> equivalent have been saved thanks to the project activity during the first crediting year. In Weining, farmers saved an average of 782 RMB on their yearly fuel expenses and biogas contributes to 40% of their energy needs. In Danzhai villagers saved 75 RMB in average and biogas contributes to 65% of the energy needs.

So that proves the impact of this project on Green House Gas Emissions and also its contribution to local and sustainable development and poverty alleviation.

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## 1 Calculation Methodology

The methodology follows the Gold Standard bio-digester methodology which is also described in the PDD. There are two different climatic zones in the project, so ERs are calculated separately for each one of them. There are also two energy consumption pattern in the years. During the warmest months of the year, villagers don't heat their houses (we will call this period summer even if it is actually longer than the actual three months of summer). During the coldest months of the year, they heat their houses (we will call this period winter even if it is actually longer than the actual three months of winter). Therefore there are two monitoring surveys conducted per year, one for each energy consumption pattern, thus the monitoring period is not a full year but a season.

The ERs are then calculated for each season, and ERs for the year are the sum of the ERs for the summer and for the winter.

## 2 Climatic Zone

### 2.1 Weining

This zone is located at the north west of Guizhou province. The average altitude is above 2000m and the average temperature is around 11° C. In this area the villagers start to heat their houses at the beginning of October and do so until mid February. In this zone we can identify three areas (see map) with different fuel consumption patterns: Caohai where people mostly use coal, Dajie where people mostly use firewood and Niupeng where people use both coal and firewood. Thus having a good representativeness between these three areas is important to have a right estimation of the Emission Reductions.

### 2.2 Danzhai

This zone is located at the south east of Guizhou province. The altitude is around 1000m and the average temperature around 14° C. In this area villagers start to heat their houses at the beginning of November and do so until the end of February. The fuel consumption pattern is pretty homogenous in the area, villagers mostly use firewood.

## 3 Number of Tanks

This table summarizes the number of tanks built in each climatic zone before the beginning of winter and summer. Only the tanks that are completely finished and that are producing gas at the beginning of the season are taken into account.

	Summer	Winter
<b>Danzhai</b>	<b>100</b>	<b>151</b>
<b>Weining (full area)</b>	<b>200</b>	<b>320</b>
Dajie (part of Weining)	50	50
Caohai (part of Weining)	150	150
Niupeng (part of Weining)	0	120

## 4 ER Calculation for Weining and Danzhai

### 4.1 Representativeness in Weining

This part details the way the representativeness of the baseline and the monitoring sample had been insured for the climatic area of Weining. A constant ratio between the number of beneficiaries and the number of surveys has been kept.

#### 4.1.1 Summer

Here are the data for Weining climatic zone and for the first monitoring (summer):

Area	Number of Beneficiaries	Number of Baseline Survey	Ratio Baseline/ Benef	Number of Monitoring Survey	Ratio Monitoring/ Benef
Dajie	50	15	0.3	18	0.36
Caohai	150	45	0.3	54	0.36
<b>Weining (full climatic zone)</b>	<b>200</b>	<b>60</b>	<b>0.3</b>	<b>72</b>	<b>0.36</b>

#### 4.1.2 Winter

Here are the data for Weining climatic zone and for the second monitoring (winter):

Area	Number of Beneficiaries	Number of Baseline Survey	Ratio Baseline/ Benef	Number of Monitoring Survey	Ratio Monitoring/ Benef
Dajie	50	15	0.3	15	0.3
Caohai	150	45	0.3	45	0.3
Niupeng	120	36	0.3	36	0.3
<b>Weining (full climatic zone)</b>	<b>320</b>	<b>96</b>	<b>0.3</b>	<b>96</b>	<b>0.3</b>

### 4.2 Representativeness in Danzhai

This part details the way the representativeness of the baseline and the monitoring sample had been insured for the climatic area of Danzhai. As far as possible a constant ratio between the number of beneficiaries and the number of surveys has been kept.

#### 4.2.1 Summer

Here are the data for Danzhai climatic zone and for the first monitoring (summer):

Name of the village	Number of Beneficiaries	Number of Baseline	Number of Monitoring
Jiaogui	100	88	94

#### 4.2.2 Winter

Here are the data for Danzhai climatic zone and for the second monitoring (winter):

Name of the village	Number of Beneficiaries	Number of Baseline	Ratio Baseline/Benef	Number of Monitoring	Ratio Monitoring/Benef
Jiaogui	100	84	0.84	39	0.39
jjajiao	20	17	0.85	9	0.45
Zhela	16	14	0.87	7	0.43

Paimo	1	1	1	1	1
Paidao	1	0	0	0	0
Yangwang	1	1	1	1	1
Delu	11	9	0.82	5	0.45
Shanmu	1	0	0	0	0
<b>Danzhai (full area)</b>	<b>151</b>	<b>126</b>	<b>0.83</b>	<b>62</b>	<b>0.41</b>

### 4.3 Baseline Emission

This baseline was the first one and was done during the writing of the PDD (in March 2008). The team was inexperienced and a few mistakes were made:

For the baseline survey of Danzhai, the fuel consumptions taken into account were the averages for the whole year instead of the average for one monitoring period, this is not consistent with the methodology. That explains why the summer GHG emission is greater in summer than in winter for Danzhai (the summer lasts for 7.5 months and the winter 4.5). Even if it overestimates the ER for summer and underestimates the ER for winter, it shall not change the total ER at the scale of one year.

For the baseline survey of Weining, the boundary of the project was misunderstood. During summer, farmers use fuel to cook their own food but also their animals' food. But in the baseline survey, summer fuel consumption was calculated according to what the villagers said they were using to cook their own food only. Therefore the baseline consumption during summer had been under evaluated.

To solve this issue we have calculated the fuel consumption needed for pig's food thanks to the monitoring held during the summer 2008. Indeed, it was asked in this survey the fuel consumption for cooking food for the family only and the fuel consumption for cooking food for both animals and family. Therefore the difference between those two amounts is the fuel needed to cook the food for the pigs. The biogas is never used to cook the food for the animals because food for animals requires special stoves, whose size is much bigger than biogas stoves.



Here are two pictures of the big pan villagers use to cook their animals food. Those pans are too big to fit on a biogas stove provided by the project.

We used data of 51 households in Caohai and of 28 households in Dajie. We calculated the average, the standard deviation and applied a correction to take the consumption of 95% of the sample. Then this corrected average had

been added to the baseline fuel consumption of summer. This method allows us to correct the undervaluation of the baseline.

These two mistakes have not been made again in the later baseline and monitoring survey. They have been treated in a transparent and conservative way. The operating team is now more experienced and have learned from these mistakes.

Here is a summary of the baseline emissions, see the complete excel spreadsheet for full details.

<b>Climatic Zone</b>	<b>Baseline summer emissions (teCO<sub>2</sub>/unit)</b>	<b>Baseline winter emissions (teCO<sub>2</sub>/unit)</b>
<i>Weining</i>	<i>7.8</i>	<i>10.1</i>
<i>Danzhai</i>	<i>6.63</i>	<i>4.07</i>

#### **4.4 Project Emission**

Here is a summary of the project emission, see the complete excel spreadsheet for full details.

<b>Climatic Zone</b>	<b>Monitoring summer emissions (teCO<sub>2</sub>)</b>	<b>Monitoring winter emissions (teCO<sub>2</sub>)</b>
<i>Weining</i>	<i>6.9</i>	<i>8.69</i>
<i>Danzhai</i>	<i>2.47</i>	<i>3.21</i>

#### **4.5 ER**

*See the Excel spreadsheet for more detail.*

<b>Climatic Zone</b>	<b>Summer emissions reduction (teCO<sub>2</sub>)</b>	<b>Winter emission reductions (teCO<sub>2</sub>)</b>	<b>Yearly Emissions Reduction (teCO<sub>2</sub>)</b>
<i>Weining</i>	<i>0.9</i>	<i>1.44</i>	<i>2.34</i>
<i>Danzhai</i>	<i>4.16</i>	<i>0.86</i>	<i>5.0</i>

#### **4.6 Sustainable Development Indicator**

Two sustainable development indicators have been monitored: the cost of energy and the % of traditional fuel in total energy requirement.

##### **4.6.1 Calculation Methodology**

###### **Cost of energy**

Average prices have been applied to each fuel. Then with the consumption the expense has been calculated for each beneficiary.

###### **Percentage of traditional fuel in total energy requirement**

To calculate this indicator we make the assumption that the total energy requirement remains the same in the pre and post project situation. This is consistent with the chosen baseline: pre-project situation without suppressed demand.

In the baseline situation the villagers don't use any renewable energy so the % of traditional fuel is 100. To calculate the indicator in the project we calculate the energy spent in the baseline and in the project with traditional fuel. Then we have:

$$\%TF_p = \frac{NRJ_{MT,trad,p}}{NRJ_{BL,trad,p}} \quad (1)$$

Where:

%TF: Percentage of traditional energy in total energy requirement

NRJ<sub>MT,trad</sub>: Energy generated by traditional fuels consumption in the project situation

NRJ<sub>BL,trad</sub>: Energy generated by traditional fuels consumption in the baseline situation

$$NRJ_{BL,trad,p} = \sum_h F_{BL,i,h,p} * NCV_i \quad (2)$$

Where:

F<sub>BL,i,h,p</sub> = daily consumption of the fuel *i* by the household *h* during the period *p* in the baseline situation.

NCV<sub>*i*</sub>: Net Calorific Value of the fuel *i* (IPCC 2006 data)

$$NRJ_{MT,trad,p} = \sum_h F_{MT,i,h,p} * NCV_i \quad (3)$$

Where:

F<sub>MT,i,h,p</sub> = daily consumption of the fuel *i* by the household *h* during the period *p* in the project situation.

NCV<sub>*i*</sub>: Net Calorific Value of the fuel *I* (IPCC 2006 data)

## 4.6.2 Results

### 4.6.2.1 Cost of Energy (in RMB)

#### 4.6.2.1.1 Summer

<i>Climatic Area</i>	<i>Baseline</i>	<i>Project</i>	<i>Difference</i>
<i>Weining</i>	<i>313.8</i>	<i>98.5</i>	<i>213.4</i>
<i>Danzhai</i>	<i>8.5</i>	<i>4.2</i>	<i>4.3</i>

#### 4.6.2.1.2 Winter

<i>Climatic Area</i>	<i>Baseline</i>	<i>Project</i>	<i>Difference</i>
<i>Weining</i>	<i>1634</i>	<i>1067</i>	<i>568.5</i>
<i>Danzhai</i>	<i>127.2</i>	<i>56.1</i>	<i>71.1</i>

#### 4.6.2.1.3 Whole Year

<i>Climatic Area</i>	<i>Baseline</i>	<i>Project</i>	<i>Difference</i>
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<i>Weining</i>	<i>1947.7</i>	<i>1165.5</i>	<i>781.9</i>
<i>Danzhai</i>	<i>135.7</i>	<i>60.3</i>	<i>75.4</i>

So this data shows that biogas allows farmers in areas where coal is used to save a substantial amount of money (in average 782 RMB/year). In woody areas, as the wood is a free energy, the financial impact is more limited.

#### **4.6.2.2 Percentage of traditional fuel in total energy requirement**

##### **4.6.2.2.1 Summer**

<i>Climatic Area</i>	<i>Baseline</i>	<i>Project</i>	<i>Difference</i>
<i>Weining</i>	<i>100</i>	<i>51</i>	<i>49</i>
<i>Danzhai</i>	<i>100</i>	<i>24</i>	<i>76</i>

##### **4.6.2.2.2 Winter**

<i>Climatic Area</i>	<i>Baseline</i>	<i>Project</i>	<i>Difference</i>
<i>Weining</i>	<i>100</i>	<i>72</i>	<i>28</i>
<i>Danzhai</i>	<i>100</i>	<i>52</i>	<i>48</i>

##### **4.6.2.2.3 Whole Year**

<i>Climatic Area</i>	<i>Baseline</i>	<i>Project</i>	<i>Difference</i>
<i>Weining</i>	<i>100</i>	<i>58.9</i>	<i>41.1</i>
<i>Danzhai</i>	<i>100</i>	<i>34.5</i>	<i>65.5</i>

So biogas can provide 40% of the energy requirement in Weining, whereas it can provide 65% in Danzhai.

Hence, it seems that biogas is more appreciated in Danzhai. This can be explained by the dependence of Danzhai villagers on woodfuel. They may spend hours on collecting wood and bio-digesters allow them to save a lot of time primarily devoted to wood collection. Therefore, issues are not the same in the two projects zones. Weining population benefits more from economic aspects whereas Danzhai beneficiaries benefit more from the timesaving permitted by the use of biogas.

## **5 Calculation of the ER for the project**

### **5.1 Failure Rate**

The failure rate was not properly recorded during the monitoring. But an extensive evaluation of the state of the biogas tanks was done at the end of the first crediting year. This evaluation was conducted in March and April 2009 and surveyed 783 biogas tanks out of 900 built at that time. To be conservative a tank, which is not working at the end of the year, will be considered as non-working for the full crediting year.

Here is a summary of the result of this evaluation:

<b>Area</b>	<b>Year of construction</b>	<b>Nb of tank built</b>	<b>Working %</b>	<b>Not Working %</b>
Weining Caohai	2007	150	77	23

Weining Dajie	2007	50	72	28
Weining Niupeng	2008	150	89	11
Danzhai	2007	100	76	24
Danzhai	2008	450	96	4

With these failure rates we can calculate the number of bio-digesters that are actually producing biogas for each monitoring survey in each climatic area.

<b>Monitoring survey</b>	<b>Name of each area</b>	<b>Number of beneficiaries from each area</b>	<b>Failure rate of the area</b>	<b>Average failure rate for the Survey</b>	<b>Number of tanks really working</b>
<i>Weining Summer</i>	<i>Caohai</i>	<i>150</i>	<i>23</i>	<i>24,25</i>	<i>151</i>
	<i>Dajie</i>	<i>50</i>	<i>28</i>		
<i>Danzhai Summer</i>	<i>Danzhai 2007</i>	<i>100</i>	<i>24</i>	<i>24</i>	<i>76</i>
<i>Weining Winter</i>	<i>Caohai</i>	<i>150</i>	<i>23</i>	<i>19,28</i>	<i>258</i>
	<i>Dajie</i>	<i>50</i>	<i>28</i>		
	<i>Niupeng</i>	<i>120</i>	<i>11</i>		
<i>Danzhai Winter</i>	<i>Danzhai 2007</i>	<i>100</i>	<i>24</i>	<i>17,25</i>	<i>124</i>
	<i>Danzhai 2008</i>	<i>51</i>	<i>4</i>		

## 5.2 Result at the Project Scale

Then with the average ER per working tank and the actual number of tanks producing biogas, we can calculate the amount of Emission Reductions in each area and for the entire project area during the first crediting year.

<i>Area</i>	<i>Season</i>	<b>Number of biogas tank really working</b>	<b>ER/tank/season</b>	<b>ER/Area</b>
<i>Weining</i>	Summer	151	0,90	135,2
<i>Danzhai</i>	Summer	76	4,16	315,9
<i>Weining</i>	Winter	258	1,44	372,6
<i>Danzhai</i>	<i>Winter</i>	124	0,86	106,4
<b><i>Project</i></b>	<b><i>Full Year</i></b>			<b>930,1</b>

*So according to this survey 930 tons of CO<sub>2</sub> equivalent has been saved thanks to the project activity during the first crediting year.*

*In the PDD, 1073 tons of ER were planned. So, we can say that the estimates were quite close to the reality (difference of 13.3%).*

**ANNEX I: DATA AND PARAMETER TO BE MONITORED (PDD SECTION D.2.1.1)**

<i>ID number</i>	<i>Name</i>	<i>Data variable</i>	<i>Source of data</i>	<i>Data unit</i>	<i>Measured, calculated, estimated</i>	<i>Recording frequency</i>	<i>Proportion of data to be monitored</i>	<i>How will the data be archived?</i>	<i>Comment</i>
PE.1	$N_{\text{sample}, p}$	Number of households in the monitoring sample	ID	Households	-	Twice a year	-	Electronic	A monitoring survey is conducted during each period p.
PE.2	$N_{\text{bh}, p}$	Number of beneficiaries in the climatic areas	ID	Households	-	Twice a year	-	Electronic	Number of household in the climatic area that use their biogas tank at the beginning of the period p.
PE.3	$F_{i,p,h}$	Daily consumption of fuel i of households of the monitoring sample	Survey	Kg	estimated	Twice a year	Sample (at least 60 households)	Electronic and paper	The daily consumption concerns different activities according to the type of period and climatic area. Cooking is always one of these activities.
PE.4	$MS_p$	Average fraction of livestock's manure fed into the biodigester	Survey	%	estimated	Twice a year	Sample (at least 60 households)	Electronic and paper	The fraction is estimated for all the animals whose manure is put into the bio-digester. No differentiation is made by type of animal.
PE.5	$LC_{T,p,h}$	Number of heads of livestock category T	Survey	Animals	estimated	Twice a year	Sample (at least 60 households)	Electronic and paper	The animals are the ones whose share of manure is put into the bio-digester.
PE.6	$D_p$	Average duration of the considered period p	ID	Date	estimated	Twice a year	-	Electronic	This date is estimated by monitoring the period of heating of households in the climatic areas.
PE.7	$GWP_{C_{H4}}$	Global Warming Potential of methane	IPCC Guidelines	-	-	According to IPCC's publications	-	Electronic	-
PE.8	$\mu_{nr,h}$	Non-Renewability Rate of the biomass consumed	Study	%	estimated	In case other project activities will impact on the NRB fraction	-	Electronic and paper	Original NRB studies have already been conducted. It may be updated whether indeed other project activities are initiated that would possibly have a significant impact on the NRB fraction. The methodology is given in a specific document.