Physical Feasibility of Domestic Biogas in the Upper East Region of Ghana

A report prepared for SNV Ghana, Northern Portfolio




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Abbreviations

AEA	Agriculture Extension Assistants
DADU	District Agriculture Development Unit
FYM	Farm Yard Manure
GSS	Ghana Statistical Service
HIVOS	Humanist Institute for International Development Cooperation
KITE	Kumasi Institute of Technology, Energy and Environment
LPG	Liquid Petroleum Gas
MFI	Micro Finance Institutions
MoFA	Ministry of Food and Agriculture
NGO	Non Governmental Organisation
SNV	Netherlands Development Organisation
ToR	Terms of Reference
UER	Upper East Region
VA	Veterinary Assistants
WASH	West African Short Horn
WCA	West and Central Africa

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0. Executive summary

Domestic biogas is an innovative Practice Area for the SNV West and Central Africa Region that includes SNV Ghana. SNV Ghana has to take a decision in early 2009 on whether domestic biogas is a feasible sector in Ghana to get involved. The Biogas of Africa Initiative (SNV, 2007) generally indicated a potential for 278,000 plants while a more detailed study carried out by Kumasi Institute of Technology, Energy and Environment (KITE, 2008) indicated a potential of 81,527 for the Northern, Upper East, Upper West and parts of the Ashanti Region. SNV's own rapid scan (van Waveren and van Nes, 2007) carried out in the same regions concluded that the Upper East Region showed more potential than other regions based on livestock population and density as well as on other factors such as availability of water, difficulty in acquiring firewood or other sources of domestic energy. This region would have a potential of 5,000 domestic biogas plants.

These assessments were mainly based on national and regional aggregation of data on cattle and other livestock available from censuses which were general to the region. Specific information and data from districts and even more so from the rural communities were very limited. Information gaps existed on for example, household cattle holding patterns, trend of livestock management and breeds that are being preferred, trend in agricultural intensification and practice and trend in household energy consumption and availability. Therefore the objective of this study / assessment was to generate information directly from the rural communities.

Building upon the previous studies the present assessment therefore focussed on the Upper East Region. Within this region main attention was paid in getting information from the communities as much as possible. All 9 districts were covered and 36 communities in total were visited, which is on an average 4 communities per district. This involved 658 persons (528 males and 130 females) as respondents representing 5,671 houses or compounds which are equivalent to 7,474 households.

42% of the houses or compounds have 10-19 persons living in them and 63% of the houses keep cattle. 48% of the cattle owning houses interviewed have 10-49 cattle. This will be at least 24% in terms of households who own 10-49 cattle (one house or compound is

equivalent to 1.6 households). Almost all houses keep sheep, goats and poultry and many keep pigs and donkeys in addition. In all the communities, cattle are invariably kraaled overnight and the survey data only includes cattle that are kept by the houses and are not given to Fulani. The cattle dung from the night kraal is thus available near the house.

The population census of 2000 indicates that there were 144,382 households in the Upper East Region. Extrapolating from the community level information, 24% or 28,000 households will own between 10-49 cattle. This is also the potential number of biogas plants that are feasible in the Upper East Region, which is a significant number for one region.

Various other factors or trends in the region that supplement the market potential for biogas are:

Trend in cattle population and management: Cattle population census carried out by the District Agriculture Development Units of Ministry of Food and Agriculture and figures compiled at the Regional Office indicate that every year their population has been increasing in all districts and in 2008 the population was 256,549 cattle. A trend in keeping fewer cattle but by many more households was witnessed in the communities. Associated with this trend was increasing emphasis on large cattle breeds like Zebu and Sanga (a cross breed from zebu and the West African Short Horn.) Current composition is 17% Zebu, 25% Sanga and 58% West African Short Horn. There were also increasing trends in the communities to shepherd their animals year round and to tether[1] them. The tendency to give cattle to Fulanis was also fast declining.

Trend in farm intensification: Slowly but surely farming is becoming intensive in the UER as population increased and there is pressure on land. Bush farms normally fallowed in the past is rarely left fallow. Dry season farming, which is a new trend is keeping land occupied during dry season when in the past it used to be free for cattle to roam. Cultivation of vegetables which are mostly sold requires manure. Chemical fertiliser is still used in minimum quantities as farmers can not afford them and their reliance on farm yard manure and thus the cattle is increasing.

Domestic energy situation: Most of the communities visited were not connected to the electricity grid and their source of household energy (mainly for cooking), in order of priority, comes from crop residue,

[1] Cattle are tied and left to graze in a specific spot. Cattle are periodically moved to a different location to facilitate grazing.

firewood, charcoal and dung respectively. Crop residue are not the preferred choice but as the time spent to collect firewood from the bush is ever increasing and the cost to buy them are getting higher, households are forced to rely on crop residue.

It can be concluded that there exist potential for at least 28,000 biogas installations in the Upper East Region based on cattle population and availability of dung and water. Other positive factors that will make biogas attractive for farmers are related to cattle management trends, farm dynamics and the scarcity of firewood. A detailed study into household income, financing mechanisms available, financial and economical analyses and issues related to existing capacity and skills necessary for biogas must be assessed. A pilot programme combining such a study together with piloting some biogas plant construction with identified local champions would help assess the economic viability of a biogas sector in Ghana. Funding for such a pilot programme should be investigated from SNV's recent initiatives in biogas such as the Africa Biogas Partnership Programme (SNV/HIVOS, 2008) and / or the proposal to spend the SNV accumulated funds for promoting biogas sector in Africa and Asia (SNV, 2008?).

Chapter 1: Introduction

1.1 Background

Domestic biogas has been selected as an innovative area of practice by the SNV WCA Region. This is linked with the Biogas for Africa initiative (SNV, 2007) that aims to establish 2 million biogas plants in Africa by 2020. As part of the SNV regional action plan a rapid scan was carried out by SNV in the northern region of Ghana to assess potential for domestic biogas plants (van Waveren and van Nes, 2007). Kumasi Institute of Technology, Energy and Environment (KITE) carried out a more detailed feasibility of domestic biogas plants in the Northern (North, Upper West and Upper East) and Ashanti Region of Ghana (KITE, 2008).

The African Initiative determines the technical potential of biogas in Ghana based on livestock populations to be around 278,000. The KITE study indicates feasibility of 81,527 plants for the North, Upper East, Upper West and Ashanti Regions. SNV scan indicates that based on cattle holdings and management regimes, agricultural practices as well as high dependence on firewood as energy source (which is rapidly becoming depleted) the Upper East Region (UER) would be the region with highest potential for biogas with a feasibility for around 5,000 biogas plants.

SNV Ghana needs to make a decision in 2009 whether biogas is a feasible sector to be supported / promoted in Ghana. Despite of its potentials that have been indicated in various studies, crucial information gaps still exist:

Livestock: Number and type of animals per house hold, management practices including its trends, use and availability of dung
Firewood and other energy sources: availability and its trends, cost (including time spent), willingness to change to other sources
Agriculture: trend towards intensification, fertility management, role of animals (cattle) as draught and as a source of fertiliser
Sanitation: issues in the settlements, communities
Construction costs: especially in relation to potential for localising in the region (potential local companies, availability of masons who can be trained).
Supporting systems: maintenance, extension, financing / subsidy, capacity building, quality control etc

1.2 Objectives of the study

This study limited its scope to determining the 'physical' feasibility of domestic biogas plants in the UER as earlier assessments has raised concerns about the physical potential. Although the market potential is influenced also by the economics (cost, subsidy, net returns etc), support network (extension and

maintenance, local technicians such as masons, research capacity for improved efficiency and reduced costs) as well as governance factors such as policy support, national ownership and quality control. These issues as critical as they are, will be ascertained depending on the findings of this current study.

Therefore, the objective of the current study is:

Determine physical market potential for household biogas plants construction and adoption in all districts of UER of Ghana.

Specific objectives

1. Determine the number and type of animals per house hold, management practices including its trends, use and availability of dung in all the districts,
2. Determine the sources of domestic energy, its availability and its trends, cost (including time spent), willingness to change to other sources
3. Determine if there are indication towards agricultural intensification, fertility management, role of animals (cattle) as draft and as a source of fertiliser
4. Determine whether communities have access to water sources

1.3 Methods and processes

The study team consisted of a SNV Advisor (Biogas Specialist) and a Consultant (Livestock Specialist). The field study was conducted from 12 November till 24 December 2008.

Given the resource constraints (time limitation, budget) to carry out a detailed and quantitative survey, it was decided to carry out a much focussed but qualitative study. National statistics and the two studies earlier mentioned already provided some pointers. The UER was indicated as the region with the highest potential in Ghana. This had to be matched or verified, particularly in the communities levels as much as possible because most of the data used for the former studies were not specifically looking into communities or limited to very few to provide a dependable picture from the ground. This study was therefore geographically limited to the UER. All 9 districts of the UER were covered with an average of 4 communities per district giving us a total of 36 communities studied.

The Terms of Reference (ToR) is in annex 6.1 and the field itinerary is in annex 6.2.

1.3.1 Preparatory visit to the region and districts

Prior to the team coming together at Tamale, the Consultant embarked upon a weeklong visit to the region and its 9 districts to introduce the objective of

the study mainly to the Ministry of Food and Agriculture (MoFA) and it's District Agriculture Development Units (DADU). In addition, in this visit, arrangements were also made with all the DADUs in preparation for organising community level meeting with livestock farmers. Farming households in communities that keep livestock would be selected as respondents as they would be the most appropriate ones to provide information regarding cattle/livestock and the prevailing farming situation in the community.

1. 3.2 Interview with sector representatives in the region and districts

The Team visited the regional offices of the MoFA and Forestry Commission. In these meetings the Team introduced the objective of the study as well as biogas technology in brief. Issues related to cattle specifically and livestock in general were discussed. Other issues discussed were the agricultural system and trends, domestic energy situation and trends. Livestock survey data, crop data as available were collected. District Profiles were also collected from some DADUs. Through its Agricultural Extension Assistants (AEA) and Veterinary Assistants (VA) (many of them also posted in villages) the district DADU is the sector office in closest contact with livestock farmers.

1.3.3 Group discussion in selected communities

Attempt was made to visit 4 communities in each district. The Team met with 3 communities in Talensi Nabdam and Bawku East districts and 6 in Bongo district. In the remaining 7 districts 4 communities each were met and interviewed. In total 36 communities were met that involved a total of 658 respondents of which 528 were male and 130 were female. These respondents represented 4,671 houses or compounds in the region. The meetings took place in a school, under a road side shade, under trees and even in the village market place. In some instances the meeting was complimented by passers by who became interested and started to participate. Such passing respondents are not accounted for in the number indicated as respondents (table 1).

The interview or rather the discussion was conducted in the local language of the respondents. A set of guiding issues were used to facilitate the meeting and to ensure uniformity of response between communities. See the check list used in annex 6.3.

Table 1: Communities and respondents

District	Community	No. respondents			No. of houses
		Male	Female	Total	
Bolgatanga	Ataobisi	8	-	8	55
	Atogrobisi	23	1	24	57
	Sorebisi	19	11	30	500
	Kembisi	7	14	21	100
Bongo	Aluriberubisi	9	8	17	23
	Asoreko	11	-	11	53
	Kantia	40	20	60	80
	Kasingo	7	1	8	74
	Akonka	21	5	26	70
	Tamalka	8	8	16	61
Talensi Nabdam	Peelongu	13	7	20	115
	Pawlugu-Nayiri	12	3	15	45
	Naboko-Sokoti	24	14	38	70
Kasseba Nankana Central	Korungu	5	-	5	35
	Bomia	14	1	15	232
	Abempingo	15	-	15	250
	Azureyire	8	-	8	85
Kassena Nankana West	Diba	43	2	45	58
	Nania	11	-	11	77
	Awoda	12	1	13	30
	Amanjire-Nkwanta	17	3	20	45
Bawku West	Googo-Natinga	11	-	11	150
	Timonde-Natinga	17	-	17	55
	Yarigu-Natinga	10	-	10	40
	Teshie-Sogo	10	2	12	100
Bawku East	Pusiga-Natinga	14	-	14	900
	Narango	12	-	12	102
	Zawse-Natinga	14	12	26	300
Garu Tempane	Basyonde	12	-	12	250
	Bimpiella	10	-	10	150
	Kpikpira	18	3	21	132
	Tarivago	14	6	20	105
Builsa	Nyansa	15	-	15	50
	Sinyansa-Mutiensya	13	-	13	53
	Kandema	13	7	20	34
	Nawasa	18	1	19	135
Total	36	528	130	658	4671

1.3.4 Reliability of information

The respondents were all cattle owners but as such were in actuality representing the community and not only their own household or house. The information thus collected pertained to the community and was not limited to the household of the gathered respondents.

It was much easier and therefore acquiring of information was much more precise when dealing with groups of respondents that represented communities with relatively smaller number of houses than groups of respondents that came from communities that had larger numbers of households. The Team realised that 150 houses was about the threshold above which the respondents had difficulty in becoming precise. In such

situations the Team identified respondents from each of the section that comprised of the community. These respondents coming from the various sections looked into their own section and then collated the information with their colleagues before it was finally recorded for the community. In this way reliability of the information collected was at best assured.

It has been experienced that households tend to indicate less than the actual number of cattle owned bringing down the estimate of cattle population in surveys. Among others, people still find it difficult to declare their cattle possessions as they are household assets and wealth. It can also be safely assumed that such dynamics took place during this study.

Chapter 2: Cattle in relation to the farming system in the communities

2.1 Social structure in the study communities

In the UER human settlement is mainly organised according to family lineage and in social units of houses or compounds. A house or a compound is a unit that holds one or several households and there is a "general administrator" called the land lord who is the eldest in that compound. The household comprises of a more closely related group of people eating from one cooking pot and operate more closely as an economic unit.

On the average there are 1.6 households in a house or a compound (Population Census, 2000). Table 2 shows the population and household figures for the UER split between urban and rural categories. There are 142,193 households in the UER of which 84% is rural. District wise, Bongo and Builsa are 100% rural. The rural population may actually be higher now after the split of Bawku East district into Bawku Municipal and the majority rural Garu Tempane district. Similarly, the split of Bolgatanga district into Bolga Municipal and Talensi Nabdam will contribute to the rise in proportion of rural population.

Table 2: Population and household distribution in districts of UER

District	Population	Houses	Households		Average household size
			Number	% rural	
Builsa	75,375	6,310	15,537	100	4.9
Bawku West	80,606	9,141	11,728	90	6.9
Bawku East (Bawku Minicipal, Garu Tempane)	307,917	27,474	37,357	66.5	8.2
Kassena Nankana	149,491	14,741	26,757	84.1	5.6
Bolgatanga (Bolga Municipal, Talensi Nabdam)	228,815	20,416	39,655	78.5	5.8
Bongo	77,885	10,319	13,348	100	5.8
Upper East Region Total	**920,098**	**27,474**	**144382**	**84.3**	**6.4**

Source: Population and housing census (2000)

The table 3 summarises the house composition in the districts of UER based on interview with community members in each district. Majority of houses (42%) contains between 10-19 persons. 23% houses have 6-9 persons and 14% have 20-29.

Table 3: Number of persons in houses or compounds in the study area

Average Number	Bongo	Talensi Nabdam	Bawku West	Kasena Central	Kasena West	Bawku Municipal	Garu Tempane	Builsa	Total	%
>50	19	40	0	7	0	7		6	79	0.02
40-50	15	0	17	5	0	105	15	8	165	0.05
30-39	0	50	20	17	25	0	0	69	181	0.06
20-29	20	61	131	50	45	0	118	42	467	0.14
10 to 19	100	6	111	241	95	516	290	22	1381	0.42
6 to 9	10	56	36	0	0	435	145	94	776	0.23
1 to 5	16	0	30	0	45	100	43	31	265	0.08
Total									3314	1.00

Source: Field survey
Note: This does not include data from Bolgatanga district.

2.2 Livestock in the Upper East Region (UER)

Local communities keep livestock such as cattle, sheep, goats, pigs, donkeys and poultry. Here we will talk more about cattle in relation to the assessment of biogas potential in the region. The focus on cattle is due to the fact that UER has the largest density of cattle per sq. km (50) for Ghana and in terms of biogas production, they produce a sizable amount of dung that can be fed to operate a biogas plant. Excreta from other animals can also be utilised but perhaps the amount produced will only be sufficient to compliment cattle dung but not enough to substitute it. For information on other animals kept, please see Annex 6.4.

2.2.1 Cattle holding patterns in the districts/communities

In the UER, on an average 63% of the houses own cattle. These are cattle kept in house (kraaled at night) and do not include cattle, that in some cases are managed by the Fulanis at other locations. Largest percentage of cattle owning houses were in Garu Tempane district (82%) followed by Builsa (74%) and Bolga (72%). Least (34%) were in Kassena Nankana Central district (table 4).

Table 4: Proportion of houses owning cattle in UER

District	No. of houses in communities	No. of houses with cattle	% of houses with cattle
Bolga	247	177	72
Bongo	362	211	58
Talensi Nabdam	303	153	50
Kassena Nankana Central	602	206	34
Kassena Nankana West	210	121	58
Bawku West	345	194	56
Bawku East	1302	920	71
Garu Tempane	637	525	82
Builsa	272	200	74
Total	4280	2707	63

Source: Field Survey

When the range of cattle held by houses were analysed it was found that 20% hold from 6-9 and 31 % hold 1-5 cattle. It should also be stated that only 1% have more than 50 while 48% hold between 10-49 cattle. This last group is the group that has sufficient number of cattle and will most likely be relevant for biogas adoption (table 5).

Table 5: Cattle holding pattern in houses

Av. Holding	Districts									Total	% houses
	Bolga	Bongo	Talensi	Kassena Nankana Central	Kassena Nankana West	Bawku West	Bawku East	Garu	Builsa		
>50						15			10	25	1
40-49		8	8	9	5	75	35		4	144	5
30-39		30		1		20	35	10	39	135	5
20-29	14	14	7	10	19	6		20	21	111	4
10-19	91	33	80	48	25	35	375	187	42	916	34
6-9	15	59	3		30	6	350		74	537	20
1-5	57	67	55	138	42	37	125	308	10	839	31
Total	177	211	153	206	121	194	920	525	200	2707	

Source: Field Survey

2.2.2 District livestock population

District Agriculture Development Units (DADUs) regularly carry out livestock census in their respective districts. The number of districts in the UER has been increasing from 6 in 2000 to 9 in 2008 (table 6). Garu Tempane and Kassena Nankana West were the most recent additions. This meant that new districts only possessed data for the most recent year(s).

Table 6: Cattle population in the districts of UER

Year	Bongo	Kassena Nankana Central	Kassena Nankana West[2]	Talensi Nabdam[3]	Builsa	Bawku Municipal	Bawku West	Bolga	Garu Tempane	Total
2002	20787	43569	-	-	-	-	12584	-	-	76940
2003	23947	46979	-	-	-	-	13009	-	-	83935
2004	25835	49820	-	-	26502	5686	23701	16425	13760	161729
2005	27081	50652	-	-	27709	6818	24208	17670	15121	169259
2006	28955	48928	-	-	28154	6471	26629	39920	16480	195537
2007	31200	54252	-	-	29947	6524	29292	42580	17963	211758
2008	-	57112	-	22725	30845	17916	32221	44950	19580	225349

Source: MoFA Regional Office and DADUs

The estimated total number of cattle for the whole region of UER amounts to about 225,349 in 2008. This data still does not include the 2008 figures for Bongo district which indicates that inclusive of Bongo the number will be larger by at least 31,200 (equivalent to the cattle population in 2007) to 256,549. District wise cattle and other animal holding in annex 6.5.

[2] Kassena Nankana West is a new district split from Kassena Nankana Central. Cattle data for Kassena Nankana Central therefore includes the number for Kassena Nankana West.
[3] Another new district, the reason why cattle data are available for only this year.

Table 7 shows the cattle population for the 4 regions of Ghana and the average cattle holding per household as reported in the Ghana Statistical Service Survey where the population of cattle indicated is much higher (454,112) than the data acquired from the regional and district MoFA livestock surveys. The average cattle holding are 11.5 per household according to the GSS data. According to the field survey majority of houses (42%) have 11-19 cattle which come to around 10 cattle per household as a house or a compound will have around 1.6 households.

Table 7: Distribution of Cattle Population in selected four regions

Region	Cattle Pop.	No. of Cattle owning Households	No. of Cattle Owning Agric. Households	Av. Cattle per household
Northern	982,847	98,090	85,142	11.5
Upper West	787,681	28,250	23,645	33.3
Upper East	454,112	47,577	39,441	11.5
Ashanti	36,355	6,455	4,874	7.5
TOTAL	**2,260,995**	**180,372**	**153,102**	**14.8**

Source: Ghana Statistical Service, GLSS 5 Provisional Results, 2008 as quoted in: Feasibility Study Report on Domestic Biogas in Ghana – Revised Draft. KITE. March 2008.

2.2.3 Livestock and cattle population trends

Table 6 above shows that the number of cattle in the region has been increasing every year. Individual districts as well as the whole region show the same trend. Similar to the increasing trend of cattle, other livestock such as sheep, goats, pigs and poultry also show an increasing population trend (Annex 5).

Out of a total of 36 communities visited, 19 (52%) communities said that the number of cattle was generally decreasing over the years. 17 (48%) communities stated that the number of cattle was increasing (annex 6.6). Decrease was reported mainly due to the need to sell animals for purchase of food to meet shortages, for generating school fees for children and loss due to diseases and theft. The number of cattle/animal sold could not be verified which would have given the real picture of the numbers that was there to start with. It was however stated that although number of cattle in houses or compounds have somewhat decreased, many more houses and households are now keeping cattle and thereby the general cattle population in the community may actually have increased.

2.2.4 Cattle breeds and their trend

The most common breed of livestock is the West African Short Horn (WASH). WASH is more resistant to Trypanosomiasis (causing sleeping sickness). Most communities however kept a mix of cattle including Zebus, WASH and the cross breeds or Sanga. Only four communities (11%) out of 36 were keeping purely WASH. On an average, Zebus constituted 17%, Cross breds 25% and WASH 58% of their cattle holding. Communities keeping Zebus said that over the years the numbers of Zebus and cross breeds are gradually increasing. Zebus are said to be stronger, fetch more value and are more docile. Improved availability of water also favoured the increase.

The breeds of cattle in the Upper east Region:

The Zebu – This is humped cattle and in West Africa, the common varieties of zebus are the White Fulani, the Sokoto Gudali and the Red Bororo. Zebus are more common in the drier parts of West Africa than in humid parts. Since these animals roamed freely together and mated without restrictions, it is difficult to spot their pure forms. Height ranges between 150 -165 cm at the hip bone. Average weight is around 120 and 300 Kg at one and three years old respectively. These cattle on the average can gain 280 g live weight per day between birth and one year and 250 g between one and three years. They yield about four litres of milk without feed supplementation in the wet season. Zebus are less tolerant to worm and tick infestation as well as trypanosomiasis, a disease in the more humid areas transmitted by tsetse flies. The average fresh dung yield of one zebu is 5.6 and 3.7 Kg under intensive kraaling and overnight kraaling respectively.

Sanga – When a zebu mates a WASH, the resulting offspring is a Sanga. The height of a Sanga ranges from 120 to 150 cm at the hip bone. They weigh on the average, 90 and 250 Kg at one and three years old respectively. These cattle on the average can gain 200 g live weight per day between birth and one year and 230 g between one and three years. They have more stamina than zebus though less strong, but much stronger than WASH as working animals. They tolerate worms, ticks and trypanosomiasis better than Zebus, but less than WASH. These cattle yield an average of 2.5 litres of milk in the wet season without any supplementary feed. The average fresh dung yield of a Sanga per day is 4.8 and 3.0 Kg under intensive kraaling and overnight kraaling respectively.

WASH – It is a short and smallish cattle adapted to the wetter parts of West Africa. It has a height of 100 to 125 cm at the hip bone and attains 80 and 220 Kg at one and three years respectively. Average daily gains of 186 and 194 g are obtained from birth to one year and from one to three years respectively. The WASH is the most tolerant to worm, tick and trypanosomiasis attacks among the three breeds. They have less strength as working animals than Zebu and Sanga. It yields about 1.2 litres of milk per day in the wet season without feed supplementation. The average fresh dung yield of a WASH per day is 3.5 and 2.4 Kg under intensive kraaling and overnight kraaling respectively.

2.2.5 Management of livestock and its trends

Livestock management varied between the wet season when most land would be covered with crops thereby restricting the free movement of cattle and the dry season when most land was devoid of crop thereby facilitating relatively free grazing by animals.

Zero grazing is not practiced in this region. Houses that rear pigs tend to keep the pigs more intensively and most of the time penned.

Management during wet (cropping) season:

The wet or rainy season is the time when farm land is full of crops and the movement of cattle including other livestock are limited. The general practice in the area is to herd the cattle during day time and bring them home during evening to kraal. Kraals are mostly found within the house or compound and sometimes near the compound. Kraals are mostly walled. Within the kraals cattle are mostly left in the open while sheep and goats have their own small

enclosure, which tend to be roofed. Pigs are kept in separate pens aside from the common kraal.

Herding (shepherding) is becoming more and more difficult as all children now go to school who in the past used to herd cattle. Those who can afford, hire herders and those who cannot or have fewer numbers of cattle have started tethering. Over the period of last 5 years, communities have seen an increase in the numbers who have started tethering.

Houses who own animals for traction – for ploughing for example, the bullock and for transportation for example, the donkey tend to tether them.

Management during dry season

During dry period when the land is usually devoid of crops almost all houses let their cattle and other animals free to roam. However, in many communities dry season cropping or "gardening" is picking up due to improved access to water such as with dug wells and other water harvesting methods (locally called dams). Tomatoes, onions, pepper, cabbages and garden eggs are some of the vegetables that are planted which sell well and help families to send their children to school. This means that even during dry periods, due to the presence of gardening, free cattle grazing is increasingly becoming restrictive. In some communities these gardens were small and fenced off with stalks or with mud walls. In others where the gardens were significantly larger and not fenced, family members remained in the garden to ward off animals. In the communities of Kornia (Kassena Nankana Central district) and Kasingo (Bongo district) where government irrigation system exists, stray animals would be a cause of conflict.

In the evening cattle are rounded up and are invariably brought back to the house kraal.

2.2.6 Role of livestock

Cattle and other livestock play an important role and are an integral part of the farming system. They also have important functions in the cultural/religious aspects of the communities.

Cultural and religious functions

Livestock are the symbol of prestige and wealth in the community. Large herd of cattle means the house is prosperous and is respected. Livestock are given as dowry to the bride side and every eligible young man must be able to do so. They are equally important for funerals and for other spiritual and religious functions

Economic functions

Livestock is an important household asset. In time of need they can be traded for cash as well as exchanged. Houses sell animals to be able to buy food and for health care such as paying hospital bills and cost of medicine.

Schooling of children is financed through sale of livestock. One of the reasons stated for the decrease in animal numbers in several communities was attributed to an increasing number of them being sold to pay for school fees as most of the houses are now invariably sending their children to attend school. In many communities respondents said that sale of cattle and other animals helped them to raise money to construct or repair their houses.

Role in the farming system

Livestock plays a crucial role in these farming communities as the sole supplier of Farm Yard Manure (FYM). As use of chemical fertiliser is minimal, crop production depends mainly on the nutrient supplied by the FYM. Its role becomes ever more important as more and more crop residues or "stalks" are consumed as domestic fuel source due to increasing scarcity of firewood resulting in faster depletion of soil nutrients.

Bullocks are increasingly being used for ploughing the fields while mechanisation is still remote. Bullocks tend to be tethered and provided supplementary food especially during cropping season. Farmers prefer the cross bred or Zebu bullocks for draught power as they are stronger.

Animals like donkeys are important source of traction as they are used for transporting all kinds of materials such as water, firewood and crops and transporting men. They are used to transport fruits, vegetables and other crops to the market for sale.

2.2.7 Availability of dung and its state of management

The dung and other animal manure collected by the house are from the overnight kraaling of the animals. Some people, especially women collect dung from elsewhere if required when they have to plaster their house walls and use it to trap termites to feed their poultry. In the kraal dung is mixed with crop residue placed on the kraal floor to keep the area dry. Farmers remove them in the morning and heap them outside in the open into mounds. Some houses reported adding kitchen residue and few (2 communities) reported putting them in pits to compost. In two communities Farm Yard Manure (FYM) was found collected under the shade of a tree within a cement block perimeter. Majority of FYM was heaped directly on the open.

FYM is then applied to their crops during season. Almost all the communities stated that the amount of FYM was not sufficient. One of the reasons why they did not send their cattle to the Fulanis was because of the FYM need.

Farmers use some chemical fertiliser for their dry season gardening. For their wet season crops as well as for the dry season gardening majority depend on farm yard manure.

2.3 Domestic energy situation

There were four main sources of fuel for domestic use in the study communities. These included Crop residue (stalks of millet, sorghum and corn cobs), firewood, charcoal and cow dung. None of the respondents reported using electricity, LPG or kerosene for cooking purposes.

2.3.1 Role of Firewood and other energy sources

In most of the districts, crop residue or 'stalks' was the most used source of energy because it was readily available on farm. The most common crop residue in use was millet stalks, sorghum stalks and corn cobs. Firewood ranks next followed by charcoal. Although communities in 8 districts out of the 9 reported use of cow dung, the intensity of use was however low for most. In Bawku Municipal, Bawku West and Garu Tempane districts cow dung was significantly used as fuel for cooking. Table 8 shows the ranking of each fuel source in the districts and the region as a whole.

Table 8: Ranking of fuel sources in the UER

DISTRICT	CROP RESIDUE	FIREWOOD	CHARCOAL	Cow DUNG
Bolgatanga Municipal	4	3	2	0
Bongo	4	2.8	2.2	0.2
Talensi/Nxbdam	3.3	3.3	2.3	0.3
Kasena/NankanaCentral	3.75	3.2	1.75	0.75
Kasena/Nankana West	3.25	3.25	2.50	0.75
Bawku West	3.75	3.25	1.25	1.50
Bawku Municipal	3.67	2.67	1.00	2.33
Garu/Tempane	3.75	3.00	1.75	1.50
Bulsa	3.00	3.75	2.60	0.25
All	**32.47**	**25.97**	**18.35**	**7.50**

Source: Field survey
Note: A higher ranking indicates most used.

2.3.2 Availability of firewood and other energy sources

Communities either harvested or bought firewood. The sources of firewood for harvesting are dwindling. Women from 83% of communities surveyed spent at least half a day to fetch firewood; a few reported they have to spend the whole day. It was reported that the distance travelled is progressively increasing as years pass and although a majority still collect, the number of households buying firewood as against those collecting is also increasing.

A bundle of firewood is estimated at 30 Kg and this will last a family of ten for five days. More than 40% of the houses in the UER have around 10 persons in the family (table 3). This would mean that a house would need at least 2200 kg of firewood each year if they do not use crop residues and other sources. A bundle of firewood is reported to cost around 10,000 GHC in the communities visited. Household buying firewood will spend about 730 GHC for firewood in a year.

As high as 83% of the communities interviewed reported that several houses in their communities bought firewood or charcoal or both for domestic use. While 11% of the communities stated that none of the houses in their communities were buying any of these. Another 5.6 % stated that some households in the community rather sold firewood or charcoal (table 9).

Table 9: Prevailing situation in the communities in respect of firewood and charcoal use.

District	No. of Communities		
	Buying	Not buying or selling	Selling
Bongo	4	2	0
Bolgatanga Municipal	3	1	0
Talensi/Nabdasm	2	0	1
Kasena/Nankana Central	4	0	0
Kasena/Nankana west	3	1	0
Bawku West	3	0	1
Bawku Municipal	3	0	0
Garu/Tempane	4	0	0
Bulsa	4	0	0
Total	**30**	**4**	**2**
Percentage	83.3 %	11.1 %	5.6 %

Source: Field survey

2.3.3 Willingness to Change to alternate Sources

It is important to note that the use of crop residue as fuel is a result of the scarcity of the other preferred fuel sources. The burning of crop residue creates a lot of smoke which is a health problem and it takes more time to wash utensils clean. At times the utensils are never washed clean. More time is spent tending the fire during cooking and less of these materials are available for the production of Farm Yard Manure.

Communities are experiencing an increasing scarcity of firewood and charcoal. Firewood is normally harvested from naturally growing trees in the bush and this resource is under extreme pressure due to population growth.

Under these circumstances, switching to an alternative fuel source such as biogas may not be a problem. The idea of biogas was completely new to the people. Yet they all said they needed it and wondered whether this innovative technology will actually be brought to their communities.

2.4 Agriculture

Agriculture is the main stay for all the communities visited and in fact also for the region itself. The farming tends to be mainly subsistence and those that sell their products mainly do so at their local market.

2.4.1 Nature of the farming system

The farming system comprises of a mix of arable cropping and animal rearing. These two components of the farming system are interdependent. All houses keep livestock in various combinations (sheep, goats, pigs, donkeys and poultry). 63% of the houses in surveyed communities keep livestock.

Cropping is carried out in two types of fields. The bush farm, which is normally at a distance from the house and the compound farm, which is closer to the house. Increasingly, households are also engaging in dry season gardening where water is available. The bush farm is mainly for arable crops while the "garden" and/or a portion of the compound where watering is possible is planted with various vegetables mainly meant for sale.

2.4.2 Farming trends in communities

Communities generally indicated that land for cultivation is becoming scarce as population grows. Bush farms were normally fallowed in the past for 5 or at least 3 years. One community out of the 36 surveyed indicated that some houses fallow their bush farm for about 3 years. The remaining 35 communities said they have stopped fallowing completely. Leaving land fallow would also invite the risk of others farming on them.

In the wet cropping season some of the common crops planted are millet, sorghum, rice, ground nut, soybean, various beans, sweet potato, frafra potato. Among these maize, soybean, sweet potato and some new varieties of millet that mature faster are said to be new introduction. Main crops produced during the dry season are onion, tomato, pepper, okra, cabbage, lettuce. These are mainly destined for the market.

Bigger breeds of cattle like the Zebus are increasingly introduced with the view to increasing income.

Farming and livestock are gradually transforming into economic activities as households are not only producing for their own consumption but also for the market.

2.4.3 Farm fertility management and its trends

There is decreasing land availability, coupled with decreasing soil fertility and unreliable rainfall pattern in the Upper East Region. This calls for better soil and water conservation practices. All the communities acknowledge these. Cow dung is a valuable resource in the lives of the people as it is used by all as manure and for soil improvement. However, in the present manner of use, gains from this valuable resource are not optimised. It is not composted, but mostly piled up together with other material in the open to decompose with time as the weather may support. A lot of useful nutrients such as nitrogen are

volatalised. Other organisms such as termites may also reduce its value while in the pile. Through the use of dung in biogas digesters, nutrient loss is reduced while in the digester and collection of dung will be intensified better than pertains now.

The move towards dry season gardening and lack of fallow in the farms mean more manure will be required. Chemical fertiliser is being used to some extent now for the dry season gardening but overwhelmingly it is still the FYM which is the main source of nutrient from crops.

2.5 Water availability

In all the communities visited drinking water sources are bore holes and dug wells. In two communities visited, although houses were not connected to piped water supply, the local school was and some nearby household had access to it. Source of water for cattle was streams and "dams". Shallow wells were also dug for cattle and for irrigating dry season gardens.

Women interviewed indicated that the time it normally took them to fetch water ranged from 15 to 30 minutes while in some cases up to 1 hour was reported. It was however noted that in some communities cattle had to travel further to the streams and rivers and the way to get there was difficult.

Chapter 3: Feasibility of domestic biogas digesters

3.1 Physical feasibility

Assessment of technical feasibility of biogas would involve assessing availability of dung/cattle, availability of water, domestic energy situation, financial and economical feasibility, availability of materials and skills as well as assessment of potential actors and organisations in the sector. This assessment however limited itself on "physical" feasibility by looking only into the cattle population and availability of dung, availability of water, situation of domestic energy sources, trend in farming practices and to some extent willingness of the community to switch to alternate sources of energy such as biogas.

3.2 Potential based on cattle or availability of dung:

MOFA cattle survey data (table 5) indicate that in 2008 there were approximately 256,549 cattle in the UER. The field survey shows that 63% of the houses in the community own cattle (table 3). Among the houses that own cattle 31% own from 1-5 cattle while 48% own cattle from 10-50. This section of cattle holding houses are the most probable biogas clients as cattle number below 10 may not be able to produce 20-30 kg of dung overnight that will be required to run a biogas plant of 6 m^3. 7-10 WASH will produce about 20 kg of dung in overnight kraaled situation[4]. Same number of Zebus and cross breeds will produce more dung. In stall fed condition 3 cattle was stated to produce 30 kg of dung a day which was sufficient to feed a 6 m^3 plant daily (Karki and Bajgain, 2005). All the houses in the communities that have been counted as owning cattle keep them invariably kraaled at night all year long.

Based on the number of cattle and therefore the availability of dung, and using conservative calculations using figures from table 2 and 5, a potential for at least 28,000 biogas installations in the UER can be derived at. The number will be slightly higher if we use the figure of 84% as the percentage of rural households for the UER. However if we individually calculate potential biogas numbers for each district using their individual figures for percentage of rural households the number comes down slightly lower to 28,299. District wise, Bolga Minicipal and Talensi Nabdam districts combined have the largest potential (31,129) closely followed by Bawku Municipal and Garu Tempane district combined (24,842). A Kassena Nankana Central and Kassena Nankana West district combined comes next with 22,503. See table 10.

[4] Feasibility Study Report on Domestic Biogas in Ghana – Revised Draft. KITE. March 2008.

Table 10: Potential number of biogas plants in the UER and its districts

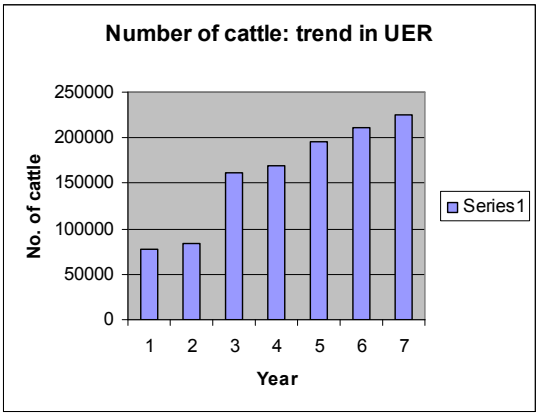
District	Households		Potential number of biogas plants
	Number	% rural	
Builsa	15,537	15,537	3,729
Bawku West	11,728	10,555	2,533
Bawku East (Bawku Minicipal, Garu Tempane)	37,357	24,842	5,962
Kassena Nankana (Central , West)	26,757	22,503	5,401
Bolgatanga (Bolga Municipal, Talensi Nabdam)	39,655	31,129	7,471
Bongo	13,348	13,348	3,203
Upper East Region	**144,382**	**117,914**	**28,299**[5]

The deduction arrived at for the potential number of biogas plants is very conservative indeed (see table 6 which has the cattle population in UER much larger). The number of household used to derive this potential number of biogas plants is based on population census of 2000, which must have increased in the 8 years that have since passed. It is also to be remembered that households provide ownership figures in relation to their cattle towards the lower side due to socio-cultural reasons.

3.3 Factors that impact on availability of dung

Number of animals: While official data on cattle population in all districts of UER indicated progressive increase, including other livestock (sheep, goats and pigs) and poultry; 48% of the community studied out of 36 indicated that cattle population in their communities were in fact increasing while 52% indicated decrease. In the meantime it was also pointed out that although each household are keeping fewer cattle, more households are now keeping cattle and other livestock than ever before and the population in the community should generally be increasing.

Figure 1: Trend in cattle number in UER



[5] 48 % of the houses in the communities own between 10-50 cattle who are the potential biogas clients. As there are on an average 1.6 households to a house, which is almost double, we therefore use 24% (half) to calculate the households than own 10-50 cattle as also suggested by Erik van Waveren and Wim van Nes (2007). This is also equivalent to the potential number of biogas plants that may be installed.

Breeds: In most of the communities visited houses were keeping Zebus, WASH and cross breeds. All of them indicated that slowly but surely they were acquiring more Zebus. Presently WASH is the dominant breed but soon the balance will tilt towards the cross breeds which are preferred as they are considered to be even stronger than Zebus for hard work. Zebu and cross breed will certainly yield more dung than WASH.

Tethering: A recent tendency witnessed in the region is tethering where cattle is tied with a long rope in a particular area to graze. Tethered cattle are moved from one location to another for grazing. Traditionally cattle were herded by young boys who now go to attend school. Adults are not supposed to herd cattle and many can not afford to hire herders whereby more and more have to tether.

Fulani herding: While Fulani[6] herding was still practiced by a few houses in a limited number of communities visited, the dominant trend was to refrain from sending cattle to the Fulani. Most important reason given was the increasing need for manure closely followed by their concern for theft and their inability to pay for the services of the Fulani respectively.

3.4 Additional dynamics that may promote adoption of biogas technology

Some important factors that will have a profound influence in making biogas plants interesting and useful to adopt are described in the following sections.

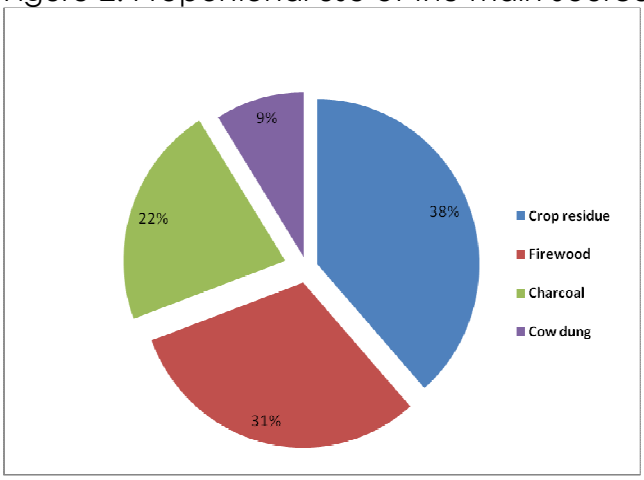
3.4.1 Domestic energy situation

- Communities are not connected to the electricity grid. Even if connected in near future electricity would be too expensive for cooking.
- LPG is out of reach, cost wise as well not being available close by.
- Crop residues being the dominant source of energy have adverse consequences on farm fertility management as well as on human health especially for women.
- Charcoal is becoming more expensive, and firewood is increasingly purchased as collecting it is becoming practically very difficult as there is hardly any left to collect around the villages. Women have to bear most of the burden of this distance and it is increasingly realised that this is at a cost of time that they can devote to other farm activities.

Fertile ground for biogas technology which provides clean energy and better manure!

[6] Fulani are a tribe of semi-nomadic community that engage in keeping livestock in West Africa (and in Ghana, mostly the northern and coastal parts)

Figure 2: Proportional use of the main Sources of Fuel in the UER



3.4.2 Cropping trends

Some scale of intensification is taking place in the farming practice. Fallow periods in bush farms are being abandoned. Cultivation is also taking place during dry season. Dry season cultivation tends to be rather intensive. Many of such dry season farms are laboriously fenced off but many too remain unfenced requiring restriction in the movement of cattle. This is already becoming evident in the form of year round herding and tendency of tethering during cropping periods. This is good news for the availability of dung as a feed for biogas digesters.

3.4.3 Water availability

During the survey it was reported that some houses in some communities may spend around one hour to fetch water. Most houses however spent between 15 to 30 minutes. Several other studies including van Waveren and van Nes (2007), and KITE (2008) indicated that in this region water availability will not be a limiting factor for biogas plant operation.

3.4.4 Interest in the technology

During the field work, the team introduced the biogas technology briefly to the participating members of the community. Out of the 36 communities visited, which consisted of more than 600 persons in total, only one person was somewhat familiar with biogas technology. As for the rest it was completely new.

Initial response from the community members was very positive. Women were especially interested. They wanted to know about the next steps that would lead to making the technology available. We must be careful however that

this is a preliminary interest; actual interest that can be translated into action will depend on many more information that must still be determined.

The technology was also completely new to the officials of DADU/MoFA that were met and through whom contacts were made with the communities. All of them however indicated that this seems to be a very appropriate technology given the fact that the domestic energy situation is becoming critical and for better agricultural productivity an appropriate manure management system was also becoming acutely needed.

Chapter 4: Conclusion and recommendations

4.1 Conclusion

- Considering the cattle population and thus the availability of dung and access to water there is a potential for at least 30,000 domestic biogas plants in the UER. This is a very conservative estimate as the number of cattle generated to start with is based on respondent figures which they normally tend to downsize. Using 23% for calculating number of households that have enough cattle to operate a biogas system from actually 48% of houses that own such numbers is also rather on the conservative side.
- The local community as well as the MoFA personnel agree that the number of cattle and other livestock are increasing over the years. Livestock survey data from the regional and district units of MoFA indicate this clearly. Households may be keeping fewer cattle now but many more households are keeping them than before.
- The farming system is dynamic in the UER and some of the trends that would positively affect potential market for biogas are becoming evident in the area of cattle management. The trend in reduction of free ranging of cattle, reduced trend in contracting a Fulani, trend in acquiring larger breeds that produce more dung and the need for more manure are all supportive factors for biogas.
- Changes are also evident in cropping where it starts to show signs of intensification requiring restriction on free cattle movement, requiring more draught power and manure. Although intensification in the wet season farming is rather relative while the dry season gardening is rapidly picking up, that brings the aspect of intensification much more rapidly in the picture. Dry season gardening is mainly an economic activity that will help bring in more cash into the households, part of which may be used to finance a biogas digester.
- As farming starts slowly becoming intensive in the area and at the same time the demand for manure has increased. Chemical fertiliser is still beyond the reach of most farmers, efficient and effective ways of managing manure will gain more importance.
- Domestic energy consumption is still dominantly biomass based relying heavily on crop residue, firewood and charcoal. Firewood and charcoal are the main sources during wet season when crop residue is finished. As collection of firewood from bush takes progressively much longer, more families are now forced to buy while at the same time the price for firewood and charcoal are on the rise.
- All the communities and the district officials met were positive about the technology and are ready for further assessment and next steps to be taken.

A biogas plant can be a linchpin between arable farming, animal rearing, household energy needs and the need for manure.

4.2 Recommendation on next steps

KITE (2008) has studied various aspects on assessing technical feasibility of domestic biogas sector in the northern regions of Ghana in parts of Ashanti, Northern, Upper West and Upper East Regions. Some of the next steps that SNV Ghana should take are to carry out a more detailed study in the districts of the UER paying much more attention to local situation. It is however suggested that these studies be conducted as an integral part of a pilot programme that actually constructs some domestic biogas installations in selected communities rather than carrying out yet another stand alone study.

Thus, it is recommended that SNV Ghana develops a plan, initially for the UER covering a period of one year to:

- Pilot construction of a number of domestic biogas installations in selected communities of selected districts after identifying some local change agents, perhaps jointly with the MoFA team. It is difficult to pinpoint the most potential district based on the current set of data available. The household data are from 2000 when there were fewer districts. Based on current cattle population alone (table 6) Bolga, Bawku West, Bongo and Builsa could be promising districts to start with. These plants will serve a multitude of functions - on demand side as well as the supply side - such as for demonstration, awareness raising, training, design assessment and costing.
- It should be actively investigated if the cost for such a pilot could be leveraged from the upcoming Africa Biogas Partnership Programme (SNV, HIVOS, 2008) and / or from the SNV accumulated funds that have been proposed for the development of biogas sector in some countries of Asia and Africa (SNV, Undated).
- Simultaneously undertake the following studies and activities in the districts and communities in the UER:
    - Carry out a household income survey in selected communities in all districts of UER
    - Survey availability of local enterprises that may be encouraged and trained to build biogas digesters
    - Survey of local availability (region, district) of masons who can be trained and helped to develop into entrepreneurs
    - Survey of construction materials locally available or manufactured
    - Identify potential fabricators of appliances or parts
    - Stake holder analysis and consultation: government, NGO and private sector including interested MFIs, vocational training centres (to trains masons/artisans) …
    - Develop a financing plan (resource mobilisation plan)

- Use the experience and assessment of this pilot phase to develop future programme for supporting the sector.

Chapter 5: References

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Van Waveren E and W. van Ness, Initial Assessment of Market Potential for Domestic Biogas Plants in Ghana. SNV Ghana. November 2007.

6. Annexes

Annex 6.1: Terms of Reference for the study

Terms of Reference

Assessment of physical market potential for domestic biogas plants in the Upper East Region of Ghana.

1. Background:

Domestic biogas has been selected as an innovative area of practice by the SNV WCA Region. This is linked with the Biogas for Africa initiative that aims to establish 2 million biogas plants in Africa by 2020. As part of the SNV regional action plan a rapid scan was carried out by SNV (2007) in the northern region of Ghana to assess potential for domestic biogas plants. Kumasi Institute of Technology, Energy and Environment (KITE) carried out a more detailed feasibility of domestic biogas plants in the Northern (North, Upper West and Upper East) and Ashanti Region of Ghana (2008).

The African Initiative determines the technical potential of biogas in Ghana based on livestock populations to be around 278,000. The KITE study indicates feasibility of 81,527 plants for the North, Upper East, Upper West and Ashanti Regions. SNV scan indicates that based on cattle holdings and management regimes, agricultural practices as well as high dependence on firewood as energy source (which is rapidly becoming unavailable) the Upper East Region (UER) would be the region with highest potential for biogas with a feasibility for around 5,000 biogas plants.

2. Information gap:

SNV Ghana needs to make a decision in 2009 whether biogas is a feasible sector to be supported / promoted. Despite of its potentials that have been indicated in various studies, crucial information gaps still exist:

5. Livestock: Number and type of animals per house hold, management practices including its trends, use and availability of dung
6. Firewood and other energy sources: availability and its trends, cost (including time spent), willingness to change to other sources
7. Agriculture: trend towards intensification, fertility management, role of animals (cattle) as draft and as a source of fertiliser
8. Sanitation: issues in the settlements, communities
9. Construction costs including potential for localising in the region (potential local companies, availability of masons who can be trained).
10. Supporting systems: maintenance, extension, financing / subsidy, capacity building, quality control etc

3. Objectives and scope of study:

The overall objective of this study is to:

> *Determine physical market potential for household biogas plants construction and adoption in all districts of UER of Ghana*

Due to time limitations, this study will limit its scope to determining the 'physical' feasibility of domestic biogas plants in the UER. Although the market potential is influenced also by the economics (cost, subsidy, net returns etc), support network (extension and maintenance, local technicians such as masons, research capacity for improved efficiency and reduced costs) as well as governance factors such as policy support, national ownership and quality control. These issues are critical to be ascertained once the current study yields promising results in order to promote a sustainable market for domestic biogas plants.

The specific objectives are linked to filling in the information gaps stated in section 2, items 1, 2, 3, and 4.

1. Livestock (per district):
    - Proportion of cattle owning households;
    - Herd size distribution, type of cattle
    - management practices, trends, and geographical distribution therein,
    - Availability and use of dung, trends, and geographical distribution therein
2. Firewood and other energy sources:
    - Current availability and trends,
    - Cost, and time spent,
    - willingness to change to other sources
3. Agriculture:
    - trend towards intensification,
    - fertility management,
    - role of cattle (draught, source of fertiliser)
4. Water availability
5. Sanitation (description of status in the settlements, communities)
    a. Availability and use of latrines
    b. Perception of necessity to improve sanitation
    c. Acceptability of connecting latrines to biogas plants

4. Study area

Upper East Region. Districts: Kassana – Nankana, Bongo, Bolgatanga, Bawku East, Bawku Municipal (security situation to be considered), Builse, Talensi-Nabdam and Garu-Tempane.

This selection is based on SNV initial scan (2007) and KITE Feasibility Study (2008).

5. Methodology

Desk study:

- Refine the ToR
- Review of documents.

- Identification of key areas (location) in each districts based on consultation with the livestock offices of MoFA where study will be carried out. Key criteria for selection: cattle population, cattle management, scarcity of firewood, relative intensification of agriculture.
- developing tools and techniques (guiding questions), listing of stakeholders to meet, making appointments
-

Field work:

- Key informants, focus group discussion, (some) household visits, secondary data collection
- Relevant agencies in area: DA, MoFA (regional and district offices), Forestry Division

Report writing:

- Draft report completed and discussed in Tamale
- Finale report prepared in Accra

6. Work schedule:

The assessment is planned as follows:

Activity	**Where?**	**When?**	**By whom?**
Desk work:			
Draft ToR	Accra	2nd wk Aug.	Rajesh
Recruitment Consultant	Tamale	October	Erik
Preparatory field visit: Establish contacts, prioritise districts, identify sample communities; collect information	UER	1st week November	Consultant
Finalise ToR	Tamale	2nd wk Nov. (wk 46)	Rajesh, Consultant, Erik
Field work preparation			
Team meeting	Tamale	2nd wk Nov. (wk 46)	Rajesh, Consultant, Erik
Finalising methodology list of stakeholders, visits, guiding or key questions; Finalising field programme	Tamale		Rajesh, Consultant
Field work	UER districts	3rd and 4th wk Nov, 1st and 2nd wk Dec. (Wks 47-50)	Rajesh, Consultant, Driver
Report writing			
Draft report	Tamale	3rd wk Dec. (wk 51)	Rajesh, Consultant
Finalise report	Accra	End Dec. (wk 52)	Rajesh

Note: 1st week of December is election time!

7. Team composition:

Rajesh B. Shrestha (SNV): Senior Advisor, biogas specialist
Ben Alenyorege (UDS): Consultant, Livestock specialist

The consultant has local knowledge and contacts as well as in depth knowledge of local farming systems including livelihood conditions.

8. Budget

Indicate budget amounts to GHc 16,969. This excludes salaries of SNV staff (Rajesh, Driver), as well as SNV vehicle running costs.

Budget (GHc)				
Item	**Unit**	**Rate**	**No**	**Cost**
Fees:				
Consultant	Day	200	38	7,600
DSA:	Day			
Rajesh's	Day	18	42	756
Consultant	Day	18	33	594
Driver	Day	12	33	396
Enumerators / field assistants	Day	10	33	330
Accommodation:				
Rajesh: Tamale, Bolga, Districts	Day	50	42	2,100
Consultant: Bolga, Districts	Day	50	33	1,650
Driver	Day	50	33	1,650
Flights:				
Rajesh: Accra to Tamale	return flight	350	1	350
Sub total				***15,426***
Unforeseen 10%				1,543
Total				**16,969**

Annex 6.2:

Field visit itinerary

12 – 16 November	Preparatory work in Tamale at SNV
16 November	Depart to Bolgatanga in the afternoon
17 November, morning	Meeting at Regional MoFA, Regional Forestry Commission Office and Bolgatanga DADU
17-21 November	Communities in Bolga, Bongo and Talensi Nabdam districts
22-23 November	Briefing progress at SNV in Tamale
24-28 November	Communities at Kassena Nankana Central, Kassena Nankana West, Bawku West and remaining communities in Talensi Nabdam districts
29-30 November	Free days
01 December	Meeting in Tamale and afternoon to Bolgatanga
02-04 December	Meeting communities in Bawku West and Bawku East districts
05 December	Farmer's Day: public holiday
06-07 December	Week end, Presidential election on the 7th
08 December	Public holiday: Iid
12-17 December	Garu Tempane, Builsa and remaining communities in Bolga and Bongo
18-23 December	Drafting report in Tamale, SNV

Annex 6.3:

Check list used for community level discussion

1. Information on livestock
- Houses holding cattle and other livestock
- Number of cattle and other animals kept by houses
- Management of cattle practiced and its trend
- Types of cattle breed and its trend
- Role of animals in farming system and the availability as well as use of dung

2. Information on cropping
- Types of farm holding
- Practice of fallowing and its trend
- Fertility management and trends
- Main crops planted season wise and its trend

3. Domestic fuel
- Main source of household fuel
- Source and availability of firewood and charcoal and its trend
- Use of crop residue and dung as fuel
- Cost of firewood and charcoal and its trend
- Interest in using alternate source such as a biogas plant

4. Water availability
- Sources of water for human consumption and for livestock
- Distance and time to fetch drinking water

Annex 6.4:

District wise Population of livestock in UER as per 2008

District	Cattle	Sheep	Goats	Pigs	Donkey	Poultry	Total
Kassena Nankana Central	57,112.00	89,342.00	137,280.00	32,516.00	5,874.00	449,238.00	771,362.00
Kassena Nankana West							-
Bongo	31,200.00	29,121.00	38,654.00	4,231.00	1,289.00	93,175.00	197,670.00
Talensi Nabdam	22,725.00	32,220.00	62,910.00	12,480.00	160.00	157,140.00	287,635.00
Bolgatanga Municipal	44,950.00	42,454.00	55,260.00	12,927.00	3,999.00	196,001.00	355,591.00
Bawku West	32,221.00	33,409.00	40,156.00	7,990.00	4,593.00	494,420.00	612,789.00
Bawku East	17,916.00	16,626.00	11,792.00	1,696.00	1,819.00	35,608.00	85,457.00
Builsa	30,845.00	22,887.00	24,693.00	1,349.00		76,705.00	156,479.00
Garu Tempane	19,580.00	44,454.00	36,691.00	2,983.00	1,387.00	7,577,364.00	7,682,459.00
Total	256,549.00	310,513.00	407,436.00	76,172.00	19,121.00	9,079,651.00	10,149,442.00

Source: MoFA regional and district survey data.

Annex 6.5:

Population of livestock (other than cattle) and poultry over the years

Year	District															
	Bongo		Kassena Nankana		Talensi Nabdam		Builsa		Bawku East		Bawku West		Bolga		Garu Tempane	
	Other animals	Poultry	Other animals	Poultry	Other animals	Poultry	Other animals	Poultry	Other animals	Poultry	Other animals	Poultry	Other animals	Poultry	Other animals	Poultry
2003	70,560	56,087	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2004	71,897	65,899	67,128	58,790	-	-	44,227	67,885	12,020	8,926	58,262	124,799	78,313	156,207	44,873	1,998,993
2005	73,493	93,172	125,648	163,319	-	-	48,139	68,358	28,768	30,532	64,725	371,465	78,224	196,001	53,807	3075,289
2006	87,099	103,152	180,514	276,562	-	-	50,522	71,510	32,935	36,682	70,597	408,612	95,501	119,350	62,741	4,151,640
2007	90,883	108,152	210,688	263,758	-	-	49,630	74,672	26,184	28,843	78,318	449,472	105,595	113,985	73,218	5,604,714
2008	-	-	265,012	449,238	123,780	188,805	51,008	76,705	30,903	35,608	86,148	494,420	110,641	169,175	85,515	7,577,364

Note: Other animals include sheep, goats, pigs and donkeys
Source: MoFA Regional and DADU Livestock Census Data

Annex 6.6:

Communities indicating recent cattle trend

District	Community	Indicated trend
Bolga	Ataobisi	Decreasing
	Atogrobisi	Decreasing
	Sorebisi	Decreasing
	Kembisi	Decreasing
Bongo	Aluriberubisi	Increasing
	Asoreko	Increasing
	Kantia	Decreasing
	Kasingo	Increasing
	Akonka	Decreasing
	Tamalka	Increasing
Talensi Nabdam	Peelongu	Decreasing
	Pawlugu-Nayiri	Increasing
	Naboko-Sokoti	Decreasing
Kassena Nankana Central	Korungu	Decreasing
	Bomia	Decreasing
	Abempingo	Decreasing
	Azureyire	Decreasing
Kassena Nankana West	Diba	Decreasing
	Nania	Decreasing
	Awodaa	Increasing
	Amanjire-Nkwanta	Increasing
Bawku West	Googo-Natinga	Increasing
	Timonde-Natinga	Increasing
	Yarigu-Natinga	Increasing
	Teshie-Sogo	Increasing
Bawku East	Pusiga-Natinga	Increasing
	Naranga	Decreasing
	Zawse-Natinga	Increasing
Garu Tempane	Basyonde	Decreasing
	Bimpiella	Increasing
	Kpikpira	Increasing
	Tarivago	Decreasing
Builsa	Nyansa	Increasing
	Sinyansa-Mutiensya	Increasing
	Kanwasa-Kandema	Decreasing
	Nawasa	Decreasing

Source: Field survey