



DOMESTIC BIOGAS POTENTIAL in BENIN

DESK STUDY



SNV Benin

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Summary

The energy situation in Benin is in serious need of action: the dependency on sources that are external and subject to seasonal and climate-related variations needs to be reduced urgently: commercial energy is almost entirely imported and is for the most part generated by hydroelectric systems.

Energy from biomass is almost synonymous with firewood and charcoal, other options are hardly used as yet although on a small scale wood chips and saw dust from carpentry workshops are used by urban dwellers. Government policy recommends diversification and rationalization of domestic energy sources in order to reduce pressure on dwindling forest reserves. Demand increasingly exceeds sustainable production.

Biogas is one of the options and it is identified as such in policy documents, although it seems to be seen as a solution for institutional and commercial users (service sector) in the first place and rather for generating electricity than for cooking. However, domestic biogas even though not explicitly promoted deserves to be seriously considered as an entry point. A commendable handbook-type document has been produced by the Ministry of Energy and great interest was expressed when the option was discussed.

Cattle husbandry is an important activity practised on a large scale in the northern departments. However, statistics do not allow conclusions to be drawn with regard to the modalities of cattle raising. Information on the proportion of semi-zero and zero-grazing practices is insufficient and needs to be completed through field research. Although the need is recognized and the tendency does exist there is no large-scale active policy towards the promotion of zero-grazing.

There is an important number of draught cattle according to the statistics but no details about the way they are kept during the off-season. Field research must allow more information to be obtained in this respect.

Water may well be a limiting factor but again the available statistics are insufficient and no conclusions can be drawn at this point in time.

The technology of biogas production has been introduced in Benin at least as early as the 80s. The various attempts have not been successful with the sole exception of the units installed by the *Centre Songhai* on their integrated farm in Porto Novo. Apart from using biogas production for their own energy needs - cooking and electricity generation - and fertilizer needs, the center also produces accessories and provides demonstrations and training.

The present desk study concludes that it is necessary to carry out additional field research in order to get reliable information about the number of households that have access to the required inputs on a daily and year-round basis. This research is to be carried out in selected communes of the Borgou, Alibori, Atacora and Donga departments where the largest numbers of cattle are found but where traditional transhumance practice is or was also most prevalent.

Some communes of the Oueme and Plateau departments will also be included, because semi-zero grazing is practised in those areas although on a small scale only.

1. Country Background¹

Geographical situation

Benin is located in West Africa in the tropical zone between the equator and the tropic of cancer (between the parallels 6°30' and 12° 30' latitude north and meridians 1° and 30°40' longitude east). It is bordered in the north by the river Niger that separates it from Niger, in the north-west by Burkina Faso, in the west by Togo, in the east by Nigeria and in the south by the Atlantic Ocean.



Area

The area of Benin is 114.763 km². From north to south it measures about 700 km and width varies from 125 km along the coast to 325 km at the level Tanguéta-Ségbana).

¹ Adapted and updated from government website, UEMOA website and INSAE documents.

Relief-Hydrography

The country is predominantly flat, rising slowly from sea-level to about 300 m. It comprises:

- a coastal region, low-lying sandy soils bordered by lagoons;
- a plateau of ferruginous clay;
- a plateau of silica-clay soils with some forest galleries;
- in the north-west the mountain chain of the Atacora (589 m.);
- in the north-east the plains of the Niger with very fertile silica-clay soils.

Several rivers cross the country:

- *the Niger basin which includes the tributaries of the Niger:*

- the Mekrou, 410 km;
- the Sota, 250 km;
- the Alibori, 338 km;
- and the Pendjari.

- *the Coastal Basin whose rivers flow into the ocean along the Benin coast:*

- the Oueme, 510 km
- and the Mono, 350 km.
- the Couffo, 190 km;

- *in addition there are several lakes in the south:*

- lake Nokoue: 138 km²;
- and the lagoon of Porto Novo: 35 km²;
- lake Aheme: 78 km²;

Climate, vegetation and fauna

The climate

Two types of climate prevail:

- *the subequatorial type climate in the south which comprises the following seasons:*

- a main rainy season from April to July;
- a minor dry season from July to September;
- a minor rainy season from September to October;
- a main dry season from November to March.

- *the Sudanese type climate in the north comprising two seasons:*

- a dry season from November to May;
- a rainy season from June to September.

The vegetation

Three types of vegetation characterize the country:

- arborous savanna in the Sudanese region in the north;
- Savanna in the center with essences such as Acajou, Iroko, and Samba;
- forests in south-central and southern Benin.

The fauna

Two (2) national parks in the north:

- the Pendjari: 275.000 ha;
- the 'Double V' or "W": 502.000 ha.

Elephants, buffaloes, hippopotamuses, lions, leopards, cheetahs, crocodiles, antelopes, many species of birds, monkeys, reptiles, insects etc. can be seen in both parks.

Population

Total population: 6.769.914 inhabitants.

Female: 3.485.795 inhabitants

Male: 3.284.119 inhabitants

Urban: 38,85 %

Rural: 61,15 %

Growth rate: 3,2 % per annum.

Households

Number of households: 1.210.463.

Urban households 514.142

Rural households 696.321

Average household size: 5,59 p.

Urban average: 5,12 p.

Rural average: 5,95 p.

Religions

Catholics:	27,1 %
Muslims:	24,4 %
Voodoo, & other traditional religions	23,3 %
Methodists and other Protestants	5,4 %
Other Christians:	5,3 %
Celestians:	5,0 %
Other religions:	1,9 %
Undeclared:	1,1 %

Socio-linguistic groups

Fon group:	66,0 %
Adja Group:	15,2 %
Yoruba group:	12,3 %
Bariba group:	9,2 %
Fulani group:	6,9 %
Otamari group:	6,1 %
Yoalokpa group:	4,5 %
Dendi group:	2,5 %
Other:	1,4 %

Political situation

Benin is a multiparty democratic republic with a presidential regime where the president is at the same time head of state and head of government. Executive power is in the hands of the government while legislative power is in the hands of the parliament; judiciary power is independent from both. The constitution now in force dates from 1990. Parliament consists of one chamber with 83 members.

After two turns in office – from 1996 to 2006 - President Mathieu Kerekou was replaced by Dr. Thomas Yayi Boni who was elected in the second round of the presidential elections held on March 19th 2006 with 74,6% of votes against M^e Adrien Houngbédji. Mr. Boni was invested on April 6th 2006.

In recent municipal elections (on April 21st and May 1st) the political coalition movement supporting the President, *Force Cauri pour un Bénin Emergent*, is expected to have won a sizable victory as it may have gained control of up to 66% of the country's municipal councils with the second party controlling some 9%. Official results however have not yet been made public but are expected shortly.

Economy²

Benin's economy is chiefly based on agriculture which contributes around 34 % to GDP. Cotton accounts for 40% of agricultural GDP and roughly 80% of official export receipts. There also is production of textiles, palm products, and cocoa. Corn, beans, rice, peanuts, cashews, pineapples, cassava, yams, and other various tubers are grown for local subsistence. Benin began producing a modest quantity of offshore oil in October 1982. Production ceased in recent years but exploration of new sites is ongoing. A modest fishing fleet provides fish and shrimp for local subsistence and export to Europe. A number of formerly government-owned commercial activities are now privatised, and the government, consistent with its commitments to the IMF and World Bank, has plans to continue on this path. Smaller businesses are privately owned by Beninese citizens, but some firms are foreign owned, primarily French and Lebanese. The private commercial and agricultural sectors remain the principal contributors to growth.

Economic Development

Since the transition to a democratic government in 1990, Benin has undergone a remarkable economic recovery. A large injection of external investment from both private and public sources has alleviated the economic difficulties of the early 1990s caused by global recession and persistently low commodity prices (although the latter continues to affect the economy). The manufacturing sector is confined to some light industry, which is mainly involved in processing primary products and the production of consumer goods. Benin is dependent on imported electricity, mostly from Ghana, which currently accounts for a significant proportion of the country's imports. Benin has several initiatives to attract foreign capital to build electricity generation facilities in Benin in order to break this dependency. The service sector has grown quickly, stimulated by economic liberalization and fiscal reform. Membership of the CFA Franc Zone offers reasonable

² Sources : <http://www.traveldocs.com/bj/economy.htm>; <http://www.uemoa.int>

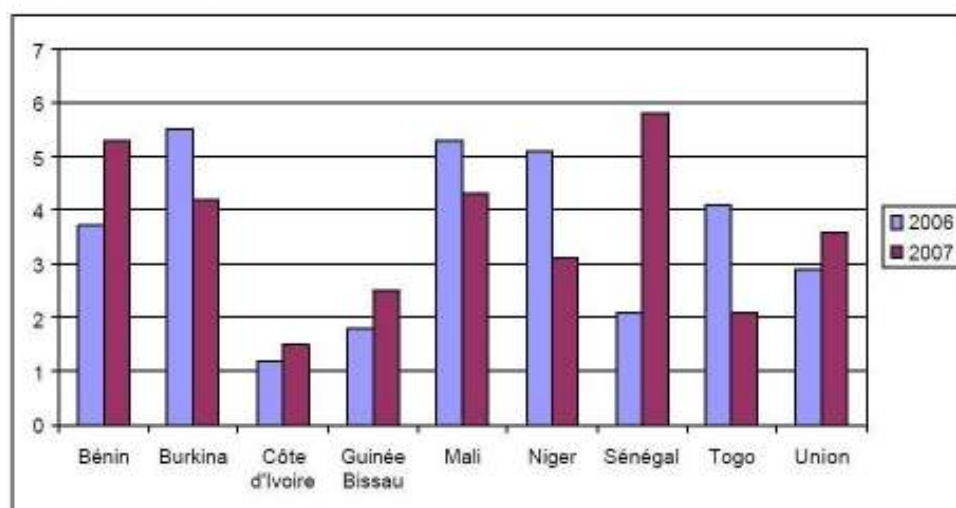
currency stability. Benin's trading partners include Germany, Brazil, U.A.E., Spain, the United States, Singapore, India, Netherlands, Japan, and China. Benin also is a member of the West African economic community ECOWAS.

In March 2003, the World Bank and International Monetary Fund (IMF) agreed to support a comprehensive debt reduction package for Benin under the enhanced Heavily Indebted Poor Countries (HIPC) Initiative. Debt relief under HIPC amounts to approximately \$460 million. Benin received \$27.1 million in 2002 and received \$32.9 million in 2003. HIPC will reduce Benin's debt-to-export ratio, freeing up considerable resources for education, health, and other anti-poverty programs.

Despite its growth, the economy of Benin still remains underdeveloped and dependent on subsistence agriculture, cotton production, and regional trade. Inflation has subsided over the past several years. Real economic growth for 2007 was 4.2%. Commercial and transport activities, which make up a large part of GDP, are vulnerable to developments in Nigeria, including fuel shortages.

In comparison to fellow member countries of the *Union Economique et Monétaire Ouest-Africaine* (UEMOA) Benin does rather well both in terms of growth and inflation.

Figure 1: Growth rate in 2006 and 2007



Source: UEMOA

GDP (2007): \$5.92 billion.

Per capita GDP (2007): \$749.

GDP growth rate (2007): 4.2%.

Inflation rate (2007): 1.3%.

Natural resources: Small offshore oil deposits, unexploited deposits of high quality marble limestone, and timber.

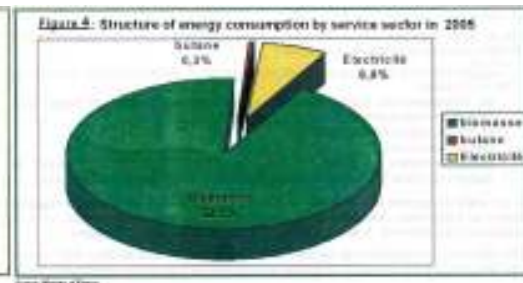
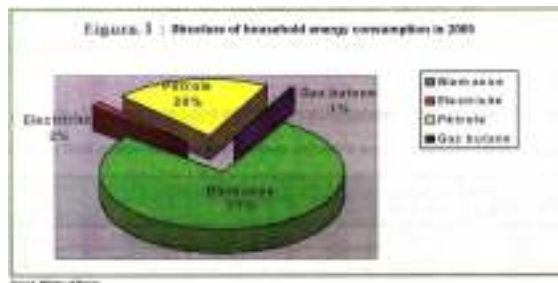
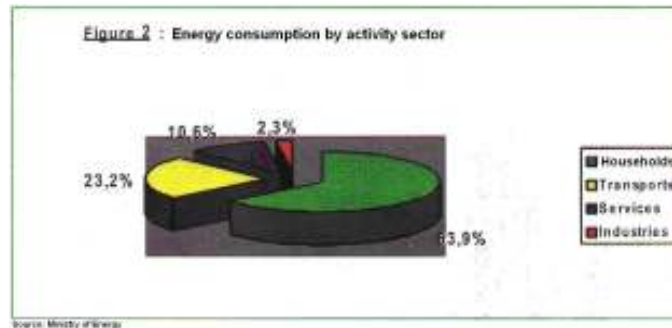
Agricultural: *Products*--corn, sorghum, cassava, tapioca, yams, beans, rice, cotton, palm oil, cocoa, peanuts, poultry, and livestock. *Arable land*--13%. Permanent crops 4%, permanent pastures 4%, forests and woodland 31%.

Business and industry: Textiles, cigarettes, food and beverages, construction materials, petroleum.

Trade: *Exports*--\$259 million: cotton, crude oil, palm products, cocoa. *Imports*--\$1.2 billion: foodstuffs, tobacco, petroleum products, energy, and capital goods. *Major trade partners*--Nigeria, France, China, Italy, Brazil, Libya, Indonesia, U.K., Cote d'Ivoire.

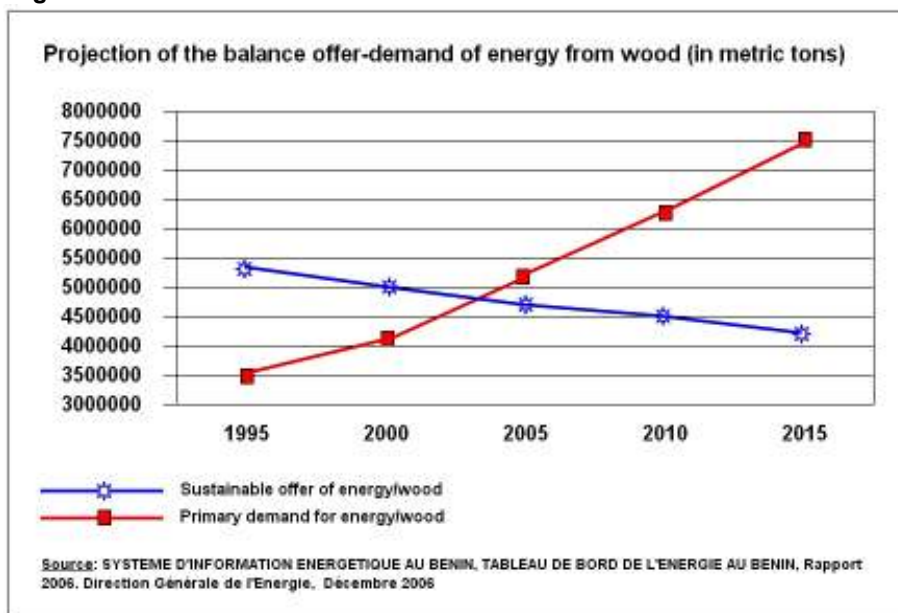
2. Energy demand and supply

For domestic purposes biomass is still by far the main source of energy as is shown in the graph below. The use of biomass in the service sector is also a factor to be taken into account even though it is not part of the intended target population. However, the two sectors taken together represent $63,9 + 10,6 = 74,5$ % of total energy consumption and, at the same time, present the most realistic target for energy source substitution.



While theoretically the sustainable offer of firewood and charcoal was sufficient in relation to demand up to around 2004, by 2005 demand started to exceed the former. If allowed to continue unchecked the imbalance will increase rapidly and result in unacceptable overexploitation of forest resources with serious negative impacts in all respects: environmental, agricultural and energy supply.

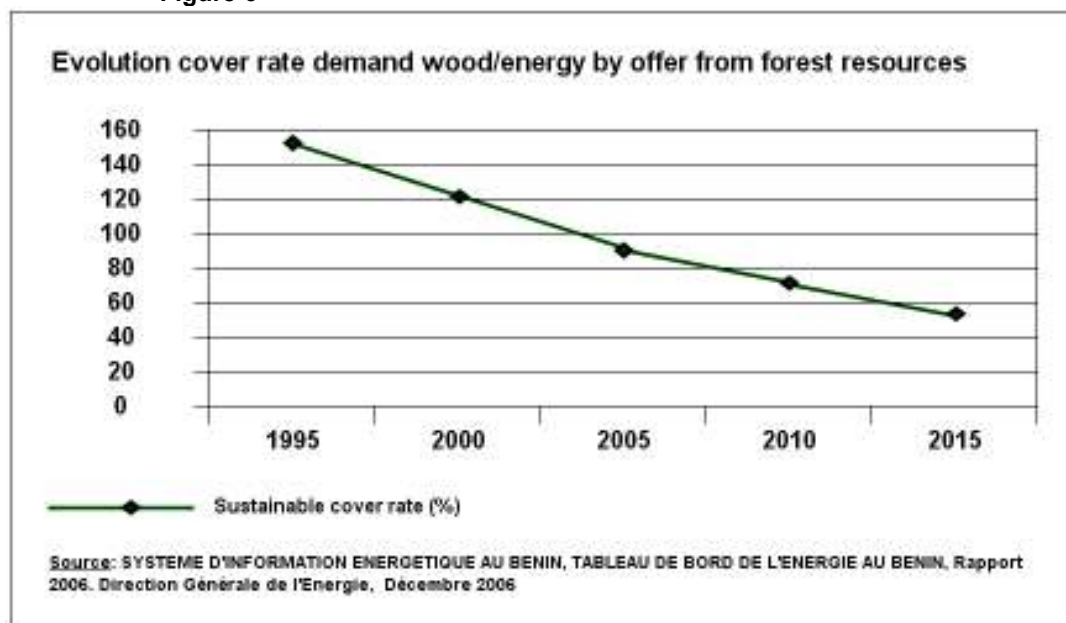
Figure 5



In actual fact the situation is worse than indicated as a consequence of regional imbalances: while the centre and part of the north are still self-sufficient, serious imbalances have emerged in the southern regions. Growing pressure is brought to bear on the resources in the centre and north in order to provide for the urban centres in the south where demographic pressure is relatively high (4,6 % and more growth per annum).

The evolution of the cover rate of demand for wood-energy by the offer predicts a fast growing deficit.

Figure 6



As elsewhere in the least developed countries the cost of firewood is not the straightforward item that it may appear to be at first sight. Those who buy their firewood will pay around 200 F.Cfa per bundle and an average household will spend around 4.000 F.Cfa per month at this price for their cooking needs. Households that buy their firewood are those that are living in urban areas or those that can afford an urban-like lifestyle. Households in the rural areas may avoid this expenditure by collecting firewood for free at the cost of (considerable) time. No detailed estimates are available. Charcoal is also used but to a much lesser extent as the cost is high, ranging from 70 F.Cfa per kg in the capital Cotonou to 40 F.Cfa per kg in the regions nearer to the production zones. It is used for specific needs such as tea making, ironing and preparing snacks.

However, in the region that is most likely to be eligible for a domestic biogas promotion programme the cost of firewood will not necessarily be expressed in monetary terms, nor will the decision maker on the household level be the person most concerned with this aspect.

3. Energy security situation

The security of energy supply is low in as much as commercial energy is almost totally imported and the self-sufficiency level dropped from 1,2 % to 1,0 % between 1996 and 2005. This is one reason why the electricity supply problems that started troubling the region in March 2006 could not be mitigated. The overall self-sufficiency level dropped from 160 % to 73,9 % over the same period, demonstrating the impending crisis in terms of biomass energy.

One of the main objectives of the government policy is to ensure increased energy security by various means, including the diversification of domestic energy sources, the improvement of present practices of biomass energy exploitation and the promotion of innovative renewable energy sources. Biogas is one of the solutions that are to be counted on in this respect.

4. Energy policy

Energy policy is the responsibility of the *Ministère des Mines et de l'Énergie* and more specifically of the *Direction Générale de l'Énergie*. One of its main planning and policy formulation instruments is the *Tableau de Bord de l'Énergie* (loosely translated: Energy Road Map), published every year. From the 2006 edition it is clear that the situation is of great concern to the government and the *Direction Générale de l'Énergie* stresses the fact that strong and ambitious measures must be taken urgently, such as:

“Implement a very ambitious policy in order to make energy available at low cost for the productive sectors and the households (modern and efficient energy services).

Indeed, if Benin wants to attain by 2011 the level of consumption per inhabitant of an emerging country like Brazil (1,1 tep per/inhabitant) it must aim at an average annual growth rate of 23,8 % for its final consumption of energy per inhabitant instead of the present rate of 3,3 %.”

Energy consumption per inhabitant stood at 0,305 tep in 2005 and attained an average yearly growth rate of only 3,28 %.

In the various recommendations that are put forward biogas is quoted more than once: to be used in the search for diversification of sources to produce electricity, but also as a substitute for traditional uses of biomass energy in general. While the potential of the use of biogas is not further developed it is very much part of the strategy.

The *Direction des Énergies Nouvelles et Renouvelables* which depends of course of the *Direction Générale de l'Énergie*, in a special report on biogas, strongly advocates the development and dissemination of this technology in rural Benin.³ It is a valuable document that augurs well for initiatives aiming at the introduction of biogas as an alternative for domestic energy supply. It has been produced in collaboration with the *Centre Songhaï* of Porto Novo, the only institution in Benin that has a long and successful experience in this particular field.

5. Agriculture and livestock

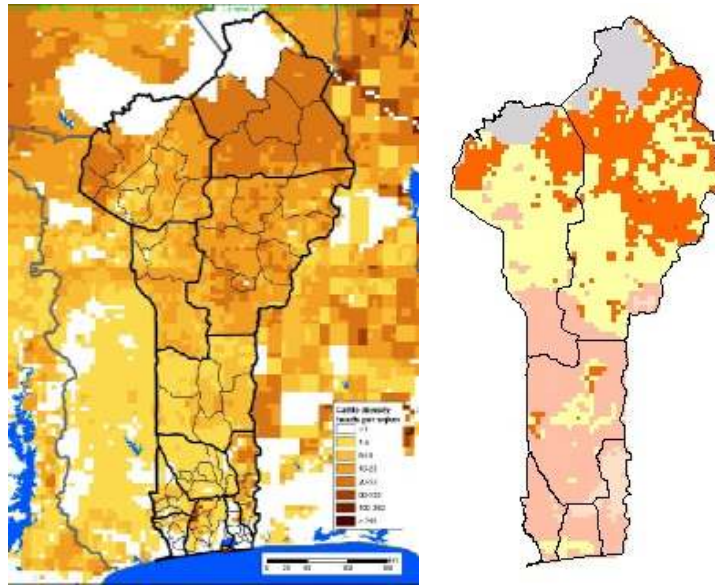
Even though cotton is a major foreign exchange earner the Beninese agriculture is still mostly subsistence farming. Almost exclusively rain-fed it is an extensive and itinerant agriculture where slash-and-burn is still practiced. Production and yields are uncertain and contingent on climatic conditions. This means that the country only produces enough food in years with sufficient rainfall not only in quantity but also in terms of space and time.

Cotton had a bumper crop in 2004-05 with 427.300 tonnes but then production fell dramatically to around 200.000 tonnes. Great ambition notwithstanding less than half the projected production was achieved in 2006-07 with 240.000 tonnes and progress is slow with 268.000 tonnes expected for the current campaign.

Cattle raising is an important sector and numbers of cattle are steadily growing at an average yearly rate of 3,3% (1990-2000). In addition to local herds there is a sizable seasonal influx from neighbouring countries as part of the nomadic lifestyle and the practice of transhumance. The maps showing cattle distribution obtained from the FAO website represent somewhat different situations, probably due to observation dates and years and/or periods of compilation etcetera.

³ Direction des Énergies Nouvelles et renouvelables, LE BIOGAZ : UNE CONTRIBUTION A LA SATISFACTION DES BESOINS ENERGETIQUES EN MILIEU RURAL, Version Novembre 2006.

Figures 7 & 8 Livestock maps



Source: FAO

What is obvious is that whatever the source, by far the largest number of cattle are to be found in what used to be the department of Borgou, now divided into the two departments of Borgou and Alibori with the latter accommodating the larger proportion. The figures given in the table below are likely to be outdated and total number of cattle may well be close to 2 million by now. However, statistics leave something to be desired in various respects: variations over time and space or in type of ownership and use are not sufficiently detailed or not explicitly specified. It has not been possible to obtain precise statistics about the movement of cattle, the proportion (if any) of year-round semi-zero and zero-grazing practice and such vital information for our purpose.

Table 1 - Number and distribution of cattle heads /department

Département	cattle heads /depart.	%-tage	cattle heads /anc. depart.	%-tage	cattle heads /anc. depart.	%-tage
	Table FAO +/- 2000 ?				Table Direction de l'Elevage Rapport 2006	
Alibori	557 519	37,9%	944 741	64,3%	1 202 500	66,4%
Borgou	387 222	26,3%				
Atacora	245 839	16,7%	346 312	23,6%	427 000	23,6%
Donga	100 473	6,8%				
Atlantique	28 198	1,9%	28 198	1,9%	32 000	1,8%
Littoral	n.a.	-				
Collines	75 972	5,2%	91 497	6,2%	91 000	5,0%
Zou	15 525	1,1%				
Couffo	9 881	0,7%	14 523	1,0%	13 000	0,7%
Mono	4 642	0,3%				
Oueme	2 143	0,1%	44 514	3,0%	44 500	2,5%
Plateau	42 371	2,9%				
TOTAL	1 469 785	100%		100%	1 810 000	100%

Sources: 1. FAO; 2. Direction de l'Elevage.

An illustration of this is found in the numbers of oxen used for draught work by farmers. It is not clear whether their number is included or to what extent they participate in the transhumance system. Some reports put the number of oxen alone (some 70.000 heads in Borgou-Alibori) at a level that could almost justify a domestic biogas promotion program – if other conditions are

fulfilled. But it is also reported that oxen are not necessarily kept on a semi-zero or zero-grazing regime all year round: if the need arises they can be allowed to join the roaming herds. In Benin as elsewhere in (West) Africa there is a tendency towards semi-zero and even zero-grazing practices in cattle raising for several reasons. Pressure on land is growing and conflicts between competing uses are on the increase so herds are losing their freedom to roam. Livestock is being genetically changed and the resulting stock can not be exposed to the rigors of the traditional transhumance. Reasons for rearing cattle are changing and with it the management becomes more geared towards dairy production and fattening for sale. While the process does not seem to be moving as swiftly as in some other countries the tendency is definitely there.

6. Water supply

Water supply in the country as a whole and in the northern regions especially is problematic and is therefore the subject of great efforts by the government and their technical and financial partners. This aspect needs further detailed study in the field if a domestic biogas programme is to be considered. However, given the attention it receives it may well be a question of implementation planning rather than a matter of cut-off condition.

Table 2 - Water Supply : basic figures

DEPART- MENT	Area in km ²	Population	Head of cattle	Water Points 2003 (WP)	Out of order	Functioning WP	Effective cover rate	Functioning WP / 1000 km ²	Inhabitant /functioning WP	Cattle head /functioning WP	Inh. + cattle /functioning WP
Alibori	26 935	533 972	557 519	1 196	20%	957	45%	36	558	583	1 141
Borgou	25 511	741 975	387 222	1 411	14%	1260	42%	49	589	307	896
Atacora	20 712	558 574	245 839	1 341	20%	1073	48%	52	521	229	750
Donga	11 146	358 010	100 473	674	23%	519	36%	47	690	194	883
Collines	13 963	547 405	75 972	1 413	21%	1130	52%	81	484	67	552
Zou	5 263	597 975	15 525	739	20%	611	26%	116	979	25	1 004
Couffo	2 353	529 342	9 881	1 042	13%	942	45%	400	562	10	572
Mono	1 610	360 061	4 642	627	19%	508	35%	316	709	9	718
Oueme	1 331	731 906	2 143	603	19%	498	17%	374	1 470	4	1 474
Plateau	3 313	414 393	42 371	644	12%	625	38%	189	663	68	731
Atlantique	3 239	833 928	28 198	1 250	15%	1063	32%	328	785	27	811

Source: Direction Générale de l'Eau

7. Potential demand for domestic biogas

Technical potential for domestic biogas in Benin was evaluated in a preliminary assessment by SNV at 254.000 units. The evaluation was based on calculations using assumptions applied to highly aggregated data and can therefore only be seen as what they were intended for: to establish a very preliminary "ball-park" figure for every country.

Country	1 agricultural households (hh x 1000)	2 agr hh with access to water	3 non-milk cattle	4 livestock factor available vs potential land (available / arable x 20% potential)	5 calculated non-milk cattle	6 domestic milk cattle	7 total domestic cattle	8 holding per agricultural household (heads of cattle / agr c hh)	9 25% of agr hh for avg holding > 3	10 50% of agr hh for avg holding > 2 but < 3	11 25% of agr hh for avg holding > 1 but < 2	12 Total Biogas Plant Potential (biogas plant potential x 1000)
1 Benin	577	338	1745	0,96	9673	210	1885	5,56	254			254
2 Burkina Faso	2068	1169	5200	0,7836	4875	1040	5115	4,38	877			877
3 Cameroon	1301	651	9990	0,9372	5576	260	5836	8,97	488			488
4 Congo DR	5559	2146	765	0,69	528	6	534	0,25	0	0	0	0
5 Gambia, The	189	111	328	0,732	248	44	284	2,56	0	56		56
6 Ghana	1967	1113	1365	0,714	973	273	1248	1,12	0	0	278	278
7 Guinée Bissau	210	104	520	0,58	302	84	386	3,71	78			78
8 Mali	1798	1118	7500	0,4372	3279	750	4029	3,68	839			839
9 Niger	1797	1057	2260	0,6515	1472	460	1932	1,83	0	0	264	264
10 Sénégal	1248	879	3100	0,685	2124	310	2434	2,77	0	440		440

Source: SNV Domestic biogas in Africa: a first assessment of the potential and the need.

While the present desk study cannot validate or invalidate the proposed figure for Benin, at this point in time it seems quite likely to be too high. The total number of cattle may be around 1,9 Million and the total number of agricultural households with access to water may be around 339.000 but the conclusion that, therefore, the average such household has 5,56 heads of cattle on a semi-zero grazing basis can not yet be drawn. However, the potential is sufficiently tempting in our view to justify further detailed research in the field.

8. Biogas experience in Benin

Biogas was introduced in Benin long ago and the technology is far from unknown. While there is no sign of widespread skepticism there is certainly no reason to speak of a success: of all the attempts only one seems to have been frankly successful: the installations at the Centre Songhaï in Porto Novo.

In 1983 a first experimental digester was installed with assistance from FAO at the *Laboratoire des Sciences du Sol, Eau et Environnement*. Positive results led to the formulation of a construction project involving 80 digesters. The project was supported by the UNDP, the FAO and the Chinese government. After an information, demonstration and training campaign 24 pilot units were actually built in the six departments. Official history loses track here but from various informants it transpires that success was at best short-lived and the experience seems to have disappeared from most memories. Those who do remember because they are professionally becoming involved agree that the main problems were not technical -although technical problems did exist- but rather managerial. Responsibilities and competences, charges and benefits, know-how and authority were not adequately distributed and led to functional problems and then to abandonment. Technical problems were not wholly absent but were related more to the selection of options than purely technical malfunction. The type of digester and the type of raw material to be used determine to a large extent such vital aspects as the possible uses and the need for maintenance and servicing. In some cases inadequate choices led to disappointments during operation.

There were also a number of attempts made by private agents such as private individuals and NGO's: the *Monastère de l'Etude* in the Borgou, the *Centre Régional pour la Promotion de l'Agriculture* (CeRPA) in the Zou, the Peace Corps in the Atlantique, EPAC/UAC at the slaughterhouse in Cotonou, The Hunger Project in Wawata, M. Mora Sika in Pehunco, Atacora, and finally the *Centre Songhaï* in Porto Novo.

Of all these attempts only the last one is frankly successful. The *Centre Songhaï* operates several digesters using various inputs such as pig manure and chicken droppings mixed with cuttings of water hyacinth that are produced in a sewage water cleaning system. The biogas operations are integrated in a complex system of agricultural and related activities. Effluent is channeled to an irrigation system. Appliances for the use of biogas such as burners and lamps are made in its workshops; compressors for the storage of biogas and engines for generating electricity are maintained and serviced in those workshops.

9. Possible supply of services for domestic biogas

The *Centre Songhaï* provides training and other services on demand and has clients in the region and it is willing and ready to collaborate in any serious endeavor to promote the use of biogas, domestic or otherwise. Contacts have already been established and it seems clear that the Center can play more than one role. It can provide training for various roles ranging from promotion and extension workers to mason, plumbers and die makers. It can carry out tests and research and it can assist in quality control and monitoring and evaluation.

Another potential provider of services or partner is the University of Abomey-Calavi and especially the department of *Génie Energétique* and the *Institut International de la Recherche et de l'Application des Bioénergies (IIRABE)*.

Where funding is concerned collaboration can be envisaged with the existing institutions of micro credit that are well represented in the whole country. Since last year, the government set up a

program of micro credit for the poor, which could be an opportunity for the access of the households to the credit if the development of a domestic biogas programme were to become effective.

Furthermore, several donor institutions and financial and technical partners of Benin are interested in cooperating in programs of renewable energy, e.g. the *Union Economique et Monétaire Ouest Africaine*, the World Bank and bilateral partners.

10. Conclusions and recommendations for action

The need to find alternative sources of domestic energy in Benin is established beyond doubt. The imbalance between the demand for firewood and charcoal and the sustainable offer for these resources is becoming increasingly problematic. The increased cost of energy coupled with the increasing cost of food can be expected to have serious socio-economic consequences. In short, never has the time been more appropriate for the development of alternative sources of domestic energy.

The potential for biogas - domestic and otherwise - is undeniable as cattle husbandry is an important sector in the northern departments. However, at this point in time the number of households that fulfill all the conditions for the installation of a domestic digester cannot be determined unequivocally. Statistics are not geared towards the needs of establishing detailed characteristics of the various types of cattle husbandry. The proportion of cattle held under semi-zero or zero grazing conditions cannot be established. There are signs that in Benin, as elsewhere, cattle husbandry systems are changing towards more intensive practices. The impression is that the change in Benin is real but relatively slow compared to, for example, Senegal or Burkina Faso or Rwanda. Even so it can be safely said that transition is ongoing and the question is not so much if there will be good potential for domestic biogas but "when will there be good potential for a market for domestic biogas digesters". Further field research needs to be carried out in order to be able to assess the situation in these terms.

In addition to the traditional herds and the cattle reared in modern practices for fattening and dairy production there is - according to the statistics - a large number of oxen used in the cultivation of cotton and maize. But here again the exact practices that are applied over the year in rearing these animals is not sufficiently documented. According to some sources a significant number of these animals also take part in transhumance during part of the year. But if the oxen are kept on a zero-grazing basis the beginnings of a market for domestic biogas digesters may already be there. Again, before reaching firm conclusions further research needs to be carried out in the field.

The cost and the effort of obtaining traditional energy sources such as firewood and charcoal is not yet a decisive factor in the larger part of the area under consideration but this situation can be expected to change fairly rapidly. The target population for domestic biogas is admittedly not the poorest section of the general population and therefore commercialization of the collection of hitherto free energy sources will have a relatively early effect.

The field study that we suggest be carried out should be limited and not seek to replace the feasibility study or part thereof. It should only address the following vital question:

How many households are there in the northern departments (Alibori, Borgou – which together account for 64 % of cattle - in Atacora, Donga, Ouémé and Plateau) that fulfill the condition of:

- **having at least 20 kg of cattle dung available on a daily basis, i.e. every day of the year,**
- **having easy access to the equivalent in volume of water on a daily basis,**
- **not having easy and free access to firewood or other sources of domestic energy.**

Annex 1 : Terms of Reference

Desk study on the potential for domestic biogas in Bénin

Terms of Reference

1. Introduction and background

Energy production is a major problem in Benin as it has little hydroelectric potential, no oil deposits so far nor any other easily accessible sources of energy. Wood is the main domestic fuel and it is available as firewood and as charcoal. It is in chronically short supply in all urban centres and even in the rural areas. In some districts millet stalks and cow dung are used as cooking fuel⁴.

In its new strategy as of 2008 SNV West & Central Africa has included the sector 'domestic biogas' as an innovative domain and as an option for intervention in the impact area Basic Services. One of the countries which selected this option is Benin.

The study carried out for SNV by Felix ter Heegde in which a first summary assessment was made of domestic biogas need and potential in sub-Saharan Africa indicates a technical potential of 254.000 units for Benin. This potential is thought to be sufficient to warrant further investigation in the form of a desk study to be carried out following the present Terms of Reference. If the outcome of the desk study is positive a full fledged feasibility study will follow.

2. Objective of the study

The objective of the study is to carry out a preliminary assessment of the feasibility of setting-up and implementing a national biogas programme in the Republic of Benin on the basis of documentary evidence and consultation with major stakeholders and government agencies.

More specifically, the study will address the following areas:

- Country background
- Agricultural & livestock sector, especially livestock (cattle) keeping practices;
- Energy demand and supply (trends, challenges, opportunities and main actors, issues), energy policy, institutional setting and plans, especially related to domestic cooking and lighting in rural areas;
- Safety situation;
- History of domestic biogas;
- Potential demand for domestic biogas;
- Possible supply of services for domestic biogas;
- Recommendation with regard to action to be taken.

3. Activities and methodologies

The following activities and methodologies are proposed:

- A. Collecting secondary information on energy consumption and needs in general and domestic consumption and needs in particular;
- B. Collecting secondary information about domestic biogas plants constructed in the past;
- C. Formulation of the draft study report and submission for comment to SNV/Benin National Team and members of the Biogas Practice Team (BPT) of SNV;
- D. Submission of the final study report by incorporating the comment from SNV/Benin National team and members of the BPT.

4. Time schedule

The study will start in the second half of January and will take about 10 working days spread over a period of 5 weeks. The draft report shall be submitted in the last week of February 2008. SNV/Benin National Team and members of the BPT will provide within 10 working days comment on the draft report. After that, the final study report will be presented within five working days.

5. Required budget and proposed financing

⁴ *Prospects for agro-forestry in Benin*, A.G. Agbahungba; <http://www.unu.edu/unupress/unupbooks/80364e/80364E09.htm>

The costs of this study will be born by the SNV/Benin ordinary budget as part of the activities in the innovation sector domestic biogas of the Basic Services Impact Area.

6. Expected output

The report on the desk study shall be well-structured and clearly written in English not exceeding 15 pages excluding annexes and provide informed recommendations on the possibilities to set-up a national biogas programme in Benin. Annex I provides a tentative table of contents for the report.

7. Composition of the team

The study will be carried out by Raoul Snelder, domestic biogas/renewable energy practice area leader for Benin. He will be assisted by the portfolio focal points for the domestic biogas/renewable energy sector for information about specific ecological areas in the country.

8. References

- Jan Lam, *Report (draft) on the Biogas Senegal Pre-Feasibility Desk Study*. SNV, Biogas Practice Team, The Hague, September 2004.
- Felix ter Heegde, Lamine Diop, Rob Ukkerman, *Report on the feasibility study on a national programme for domestic biogas in Senegal*, Agence Senegalaise d'Electrification Rurale (ASER) and SNV-Netherlands Development Organization – West Africa (SNV-WA), September 2007.
- GTZ, *Country Background Benin*, part of unpublished draft feasibility study for national domestic Ecosan-linked biogas program in Benin/Burkina Faso, February 2007

Raoul Snelder
Cotonou, 30 October 2007

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Annex 2: Details of meetings with organizations and individuals

N°	Organisation	Persons met	Contact	Synopsis of the meetings
1	Centre Songhaï	Justin LEKOTO Technicien Agricole	00229 97289752 00229 95288242 00229 20225092	The <i>Centre Songhaï</i> is located in Porto-Novo, the capital of Benin. It is a center for production, training and education. It has 4 digesters of respectively 10m ³ , 7m ³ , 20m ³ and 40m ³ capacity. With the production of biogas, Songhaï shows that it is possible to cook without destroying trees, to have light and raise animals. Songhaï collects on average per day 1000 kg chicken dejections, 500 kg pig manure and cow dung. The centre has a foundry and workshop that make simple burners for use with biogas stoves.
2	Direction de l'énergie	Dr Sakariyou MAHMAN, Directeur des Etudes de la Statistique, de la Planification et de la Règlementation (DESPR)	00229 95454517 00229 21352927	The firsts digesters installed in Benin were under the responsibility of the Ministry for energy. The direction of energy presented in November 2006 a document entitled: «le biogaz : une contribution à la satisfaction des besoins énergétiques en milieu rural » which allow to understand the experiences of biogas in Benin, opportunities and constraints which exist in the sector. Also, the ministry publish each year some datas and informations on the energy situation in Benin. Dr. Sakariyou is a person resource of the direction of energy in biogas sector and he cumulates his current functions with those of director of renewable Energies
3	Direction de l'élevage	Dr Emile G. TOTGBE Chef du service Appui au Développement des Filières Animales	0022921330285 0022995567176	The direction of the livestock maintains the contacts with the direction of energy for the promotion of biogas. Although very enthusiastic for the promotion of biogas to Benin, Dr. Emile deplored that the statistics in this sector are not current. The last census has taken place for more than 10 years. He suggested us to go to CeRPA of north (Regional Center for Agricultural Promotion), where opportunities exist for the production of biogas. For him, Benin is not a new ground for Biogas
4	Centre	Dr Alexandre	0022997885161	The Direction of the <i>Centre</i>

	Régional de la Promotion Agricole Borgou/Alibori (CeRPA B/A)	AHISSOU, Chef service Contrôle des produits d'origine animale et halieutique	0022993058632	<p><i>Régional pour la Promotion Agricole du Borgou/Alibori</i> is located in Parakou, one of three cities with a special statute in Benin. The head of the <i>Service de la Réglementation et du contrôle</i> deplored the lack of recent statistics that would have allowed to assess the department's situation in the livestock sector. The available reports present the figures of 1999.</p> <p>The <i>CeRPA</i> is available and interested to collaborate with SNV within the framework of a domestic biogas programme in the department.</p>
5	Centre Régional de la promotion Agricole Atcora/Donga (CeRPA A/D)	Marcellin ALIA GBAGUIDI, Dr Vétérinaire, Directeur Réglementation et Contrôle; Tcharo YOKOSSI, Technicien en élevage, Chef Service Contrôle des Produits d'Origine Animale et Halieutique	00229 95456609 00229 97112729 00229 90039763 00229 97015699	<p>The <i>CeRPA Atacora/Donga</i> is located in Natitingou. As in the case of the <i>CeRPA Borgou/Alibori</i>, the persons in charge in Natitingou deplore the lack of reliable statistics but are optimistic as for the feasibility of biogas in certain communes of the two departments where not all the livestock takes part in the transhumance.</p>

Annex 3: References

- Jan Lam, *Report (draft) on the Biogas Senegal Pre-Feasibility Desk Study*. SNV, Biogas Practice Team, The Hague, September 2004.
- Felix ter Heegde, Lamine Diop, Rob Ukkerman, *Report on the feasibility study on a national programme for domestic biogas in Senegal*, Agence Sénégalaise d'Electrification Rurale (ASER) and SNV-Netherlands Development Organization – West Africa (SNV-WA), September 2007.
- GTZ, *Country Background Benin*, part of unpublished draft feasibility study for national domestic Ecosan-linked biogas program in Benin/Burkina Faso, February 2007.
- Direction Générale de l'Energie, *Système d'Information Energétique au Bénin (SIE-Bénin) – Tableau de Bord de l'Energie au Bénin (TBE) Rapport 2006*, Ministère des Mines, de l'Energie et de l'Eau, Cotonou, décembre 2006.
- Sacca Lafia, Cyr Koty, Dr. Sakariyou Mahman, *Le Biogaz: une contribution à la satisfaction des besoins énergétiques en milieu rural*, Ministère des Mines, de l'Energie et de l'Eau, Cotonou, novembre 2006.
- Centre Régional pour la Promotion Agricole (CeRPA) de l'Atacora et de la Donga, *Rapport Annuel 2006*, Ministère de l'Agriculture, de l'Elevage et de la Pêche, Natitingou, avril 2007.
- Centre Régional pour la Promotion Agricole (CeRPA) de l'Alibori et du Borgou, *Rapport du Sous-secteur Elevage Année 2006*, Ministère de l'Agriculture, de l'Elevage et de la Pêche, Kandi, avril 2007.
- <http://www.gouv.bj/index.php>
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