Biogas for Better Life

Feasibility Study for a National Domestic Biogas Programme in Burkina Faso

gtz Promotion of Renewable Energies

commissioned by

Federal Ministry for Economic Cooperation and Development

FINAL DRAFT

Published by:
Deutsche Gesellschaft für
Technische Zusammenarbeit (GTZ) GmbH

Name of sector project:
Partnerschaften und Netzwerke zur Förderung erneuerbarer und nachhaltiger Energie

Coordinated by:
Heinz-Peter Mang, Center for Energy and Environmental Protection (CEEP) / GTZ-CIM (Beijing)
on behalf of Prof. Dr. Zhao Lixin, Director, Center for Energy and Environmental Protection (CEEP) (Beijing)

Contributed by:
Elisabeth-Maria Huba (M.A.), World Toilet College (WTC/WTO) (Singapore)
Dr. Papa Abdoulaye Fall, GTZ-ecosan (Paris)
Dr. Oumar Sanogo, Institut de Recherche en Sciences Appliquées et Technologies (IRSAT) (Ouagadougou)
Gombila Kaboré, Institut de Recherche en Sciences Appliquées et Technologies (IRSAT) (Ouagadougou)
Patrick Bracken, GTZ-Burkina Faso (Niamey)

Eschborn, July 2007

Index

List of tables

List of figures

List of boxes

Acknowledgments

This Feasibility Study is the outcome of joint efforts of about 290 persons from Burkina Faso and the international community, who participated actively, with dedication and willingness to contribute with in-sights and information to a potential National Domestic Biogas Programme in Burkina Faso in interviews, visits, and the Stakeholder Workshop.

Furthermore, the international multi-disciplinary GTZ Study Team is very grateful to

- Valerie Diallo and Andrea Wilhelmi-Some, GTZ-PDA Ouagadougou for supporting the Team with an excellent mission itinerary organization, and their colleagues in Fada N'Gourma, Gaoua and Diebougou
- Our drivers, who brought us safe and in time to all places in the country where we wanted to go to discover biogas digesters and people interested in poverty reduction and environmental improvements
- The interviewer teams in Fada N'Gourma, Bogande and Gaoua, who learned about biogas for the first time, and decided to work day and night in order to finalize the Rapid Household Survey on 100 households within the very limited time
- All participants in the Stakeholder Workshop, who came from far and near to express their support to a future biogas programme and their interest to play an active role in it.

Résumé *(French abstract)*

Dans le cadre de sa politique d'aide au développement, la coopération hollandaise, en collaboration avec plusieurs partenaires dont la GTZ, a récemment lancé l'initiative « Biogas for a Better Life ». Cette initiative, s'inspirant des résultats intéressants obtenus par la technologie du biogaz en Asie, et surtout au Népal, a pour objectif d'initier et de mettre en œuvre des programmes nationaux sur les unités domestiques de biogaz (PNUDB), visant à réduire la pauvreté dans les pays africains. De par son approche intégrée, cette technologie contribue en effet à répondre aux besoins des populations locales démunies en matière d'énergie, d'assainissement, de sécurité alimentaire, de développement social et économique, de protection de l'environnement et du climat.

Un préalable à la traduction de cette initiative sur le terrain étant la connaissance du pays et de son potentiel, la coopération hollandaise a mandaté à la GTZ pour la réalisation d'une étude de faisabilité au Burkina Faso pour évaluer, par une approche de marché, la faisabilité d'un tel programme. Pour ce faire, la méthodologie retenue a consisté en la réalisation d'une étude documentaire suivie d'une mission sur le terrain, comprenant des rencontres et interviews avec les autorités et autres acteurs-clé, des visites de sites, et des enquêtes auprès des ménages (potentiels bénéficiaires du programme).

Le présent rapport est le fruit de ce travail de recherche d'information, d'investigation active et de concertation, effectué par une équipe d'experts internationaux et nationaux, et qui a nécessité l'implication de plusieurs personnes ressources.

Il en ressort que le Burkina Faso dispose d'une longue (30 années) et intéressante expérience sur le biogaz, même si celle-ci était essentiellement limitée à des expérimentations de faible à moyenne envergure. Des leçons apprises de ces Programmes et projets de recherche et développement, largement soutenus par des bailleurs internationaux, il faut retenir que si certaines unités de biogaz ont fonctionné pendant plus de 12 ans (cas des installations au Petit Séminaire Pabré), la très grande majorité a cessé de fonctionner au bout de 3 à 4 années. Les raisons principales de cette situation sont multiples : connaissances de la technologie et personnels qualifiés limités, types de digesteurs développés inappropriés (principalement le type discontinu et métallique), campagne d'information et de sensibilisation insuffisante, absence de mécanismes de financement (installations subventionnées à 100% dans la plupart des cas), pas d'implication des utilisateurs et/ou bénéficiaires, donc pas d'appropriation de la technologie par ces derniers Par ailleurs, à l'époque de cette pré-vulgarisation les sources d'énergie (bois de chauffe) étaient encore disponibles et plus accessibles et les questions environnementales n'étaient pas encore d'actualité, etc.

Aujourd'hui, le Burkina Faso, pays enclavé et situé dans la zone soudano-sahélienne, fait face à plusieurs défis. Avec une population d'environ 13 millions d'habitants, dont plus de 85% est rurale, le revenu par habitant reste faible. L'économie nationale repose essentiellement sur le secteur agricole (agriculture de subsistance et l'élevage), qui fait vivre plus de 85% de la population et qui contribue pour près d'un tiers au Produit Intérieur Brut (PIB). Plus de 40% de la population vit dans l'extrême pauvreté dont l'incidence est plus importante en milieu peri-urbain et rural. Par ailleurs, le faible taux d'électrification dans ces zones (3%) a conduit à une surexploitation des forêts (utilisation du bois de chauffe et du charbon de bois représentant la principale source d'énergie soit à plus de 80%) par les populations paysannes démunies, désireuses de couvrir leurs besoins énergétiques en énergie.

Conscientes de cette situation, les autorités, soutenues par leurs partenaires internationaux, ont initié et mis en place plusieurs reformes et programmes, visant le renforcement de capacités et l'appui technique et financier des acteurs locaux non seulement pour l'amélioration de la productivité agricole, mais aussi pour renverser la tendance actuelle de la déforestation observée à travers le pays. Ces efforts ont progressivement conduit à la mise en place d'un processus d'intensification des activités agricoles dont la production laitière et l'embouche bovine; activités assurées par les agro-pastoralistes, le plus souvent organisés en associations, coopératives ou groupements où les femmes, très impliquées, jouent un important rôle. Pour accroître la production agricole par l'amélioration de la qualité des sols, l'utilisation d'engrais est fréquente mais la demande reste insatisfaite, du fait de la faible disponibilité et surtout des coûts élevés des fertilisants chimiques. Pour remédier à cette situation, le compostage à partir des déjections animales ou des résidus agricoles, est couramment pratiqué dans le monde agricole. La collecte de la fumure animale est facilitée par la stabulation semi-permanente ou nocturne, également existante.

Ces avancées dans le secteur agricole ont contribué au développement du potentiel « biogaz » actuel que nous avons pu vérifier et estimer lors de notre mission dans le pays. Ce potentiel est, d'ailleurs, renforcé par les politiques nouvellement initiées, particulièrement en matière d'assainissement, et par le rythme de croissance du secteur de l'agro-business.

Par ailleurs, les résultats des interviews et des enquêtes ménagères, effectuées principalement dans les régions de l'Est et du Sud-Ouest, montrent que les populations sont non seulement prêtes à accueillir cette nouvelle technologie, mais à consentir des investissements pour son acquisition, afin d'améliorer leurs conditions de vie (meilleure source d'approvisionnement en énergie, meilleure installation sanitaire, génération de revenus supplémentaires, etc.). Pour ce faire, les ménages ruraux comptent solliciter les systèmes de micro-finance bien implantés par les institutions bancaires comme le RCPB et la BACB, et régulièrement utilisés par les populations locales.

Les autorités gouvernementales, en particulier le Ministère de l'environnement et du Cadre de Vie et celui des Mines, des Carrières et de l'Energie, et les municipalités ont exprimé leur ardent désir de s'impliquer dans la mise en œuvre du programme. Ce même engagement a été aussi observé chez les représentants d'organismes internationaux (UEMOA, FAO, PNUD, GTZ-IS, DED, etc.), d'organisations financières (RCPB, BRS, BACB, FICOD, PAMER, etc.), des ONG et associations, et des centres de recherche et de formation.

Les conclusions du rapport, visant à recommander le PNUDB pour favoriser l'utilisation du biogaz au Burkina Faso, pourraient illustrer l'impact positif qui peut être réalisé par des programmes/projets adaptés aux besoins énergétiques de base des ménages privés. Au total, près de 230.000 personnes pourraient être ainsi servies avec cette énergie renouvelable et moderne. Dans les zones rurales, les femmes et les enfants ne devront plus passer près de 4 heures par jour pour recueillir le bois de chauffe. En zones urbaines, les familles feront des économies considérables par rapport à leurs dépenses pour l'énergie. L'effluent du digesteur sera utilisé, avec les résidus agricoles compostés, comme engrais organique de haute qualité. Dans le cas du remplacement des fosses septiques par les digesteurs, les eaux résiduaires pourraient être simplement traitées et réutilisées pour le jardinage. Les digesteurs sont des technologies fiables qui peuvent traiter les déchets pour réutiliser et réduire au maximum la propagation des microbes pathogènes et de l'azote à l'environnement. Le déboisement excessif dans l'écosystème fragile d'un pays sahélien en sera fortement réduit.

Les autres avantages du PNUDB viendraient des économies en coûts de carburant, de l'amélioration des conditions sanitaires et d'hygiène grâce à l'utilisation des toilettes familiales et d'un environnement plus assaini, de la protection des ressources naturelles, d'une réduction des émissions de CO_2 et du transfert des compétences technologiques.

Les deux composantes majeures du PNUDB consistent en:

(1) l'installation de digesteurs alimentés par les déjections animales et les produits des toilettes pour générer du biogaz, utilisé pour la cuisson et l'éclairage chez au moins 15.000 ménages d'agriculteurs, et

(2) l'installation de fosses sceptiques à biogaz domestiques pour traiter les eaux usées, les déchets organiques et les produits des toilettes pour produire du biogaz, utilisé pour la cuisson chez au moins 20.000 ménages suburbains.

La troisième composante, axée sur les petites et moyennes entreprises (PME/PMI) de l'agro-business, réduira les coûts d'approvisionnement en énergie fossile utilisée pour le traitement et la conservation des produits transformés. Les déchets organiques produits pourraient être récupérés pour améliorer la production et fournir de l'énergie (méthane) pour la production de chaleur et d'électricité. Près de 2.000 PME/PMI sont ciblées d'ici 2015.

La notion de « biogaz communautaire », sous la forme de digesteurs installés près de puits/forages, dans les lieux publics comme les établissements scolaires, les marchés municipaux, présente aussi un intéressant potentiel à explorer et à exploiter.

Au Burkina Faso, beaucoup de petites entreprises privées anonymes pourraient assurer la construction de haute qualité, l'exploitation efficace et l'entretien des unités de biogaz. De plus, la mise en œuvre d'un tel programme permettrait la création d'environ 1.200 emplois.

Les familles à revenu limité pourraient se permettre l'investissement initial relativement élevé par des mécanismes de micro-financement simples, offerts par un organisme financier proche des populations locales, tel le Réseau des Caisses Populaires du Burkina Faso. Au démarrage du programme, il sera aussi proposé l'octroi d'une subvention couvrant environ 65% des coûts liés à l'installation des unités domestiques de biogaz, et à l'équipement requis pour la cuisson et l'éclairage. Une autre source de financement serait l'intégration du mécanisme de développement propre (MDP) dans le programme PNUDB.

Toutefois, il est important de noter que l'objectif visé à moyen terme est la suppression progressive de ces subventions, parallèlement à la baisse du coût de la technologie biogaz. Le programme serait financé avec le Gouvernement du Burkina Faso, à travers l'aide financière mise à disposition par les Pays-Bas, l'Allemagne et d'autres bailleurs des fonds.

La réalisation du PNUDB se fera en deux phases. Une première phase d'une durée de deux années (**phase d'initiation)**, visant à créer un environnement propice à la phase de mise en œuvre à grande échelle (**phase d'exécution)**. Durant la phase d'initiation, près de 100 digesteurs seront installés et normalisés. Parallèlement, toutes les activités de communication, de formation et de sensibilisation seront entamées et conduites de façon soutenue à tous les niveaux, alors que la stratégie de marketing sera clairement définie et développée. L'implication du Gouvernement et de la société civile (ONG) sera fortement sollicitée durant ces deux premières années.

Les autres aspects stratégiques du programme seront l'organisation institutionnelle avec des responsabilités identifiées et clairement définies, la stratégie de marketing à long terme, la standardisation et le contrôle de qualité en termes de conception, de construction et d'utilisation des équipements, le suivi et l'évaluation à tous les niveaux, la certification (renouvelable tous les deux ans) des entreprises impliquées ainsi que les services après-vente.

Le nombre d'unités de biogaz à installer d'ici 2030 est estimé à plus que 100.000. Le programme PNUDB favorisera un concept stratégique à long terme pour une énergie domestique moderne au Burkina Faso. Ce concept pourrait être repris dans les pays voisins, permettant une diffusion et un échange d'expériences à l'échelle de la sous-région ; ce qui sous-entend les pays de la Communauté Economique des Etats de l'Afrique de l'Ouest (CEDEAO) et de l'Union Economique et Monétaire de l'Afrique de l'Ouest (UEMOA).

Principales recommandations pour la mise en œuvre d'un Programme National sur les Unités Domestiques de Biogas (PNUDB) au Burkina Faso :

- **Lettre d'Agrément / Convention**

Une Lettre d'Agrément ou une Convention devrait être signée entre le Ministère de l'Environnement et du Cadre de Vie, le Ministère des Mines, des Carrières et de l'Energie et la GTZ/SNV pour l'établissement et la mise en œuvre de la phase d'initiation du PNUDB. Ceci devrait aider à développer un secteur du biogaz viable, orienté vers le marché et acceptable socialement et culturellement. L'objectif en sera d'installer 25 000 digesteurs d'ici 2015.

- **Formulation d'un Plan de Mise en œuvre**

Ce plan dont la formulation exige la participation de toutes les parties prenantes, devra également aborder les aspects non couverts par l'étude de faisabilité. Pour ce faire, il faudra engager des consultants pour assister le personnel en charge du PNUDB.

Les parties signataires de la Lettre d'Agrément / Convention devront approuver le Plan de Mise en œuvre en vue d'entamer les préparations nécessaires au démarrage de la mise œuvre du PNUDB. Celles-ci doivent inclure la recherche de sources de financement pour la l'information, la sensibilisation, la promotion et le développement du PNUDB au Burkina.

- **Mise en place (organisation et coordination) du programme**

D'ici la fin de l'année 2007, un Bureau national du PNUDB devra être mis en place pour initier et coordonner les différentes activités afférentes à la réalisation du programme. Ce Bureau national pourra être placé sous la tutelle du Ministère de l'Environnement et du Cadre de Vie.

Parallèlement, un Comité d'Orientation et de Suivi du PNUDB sera créé et placé sous la tutelle du Ministère des Mines, des Carrières et de l'Energie. Ce comité regroupera les représentants des ministères-clés à l'image de la CIFAME, et ceux des organisations internationales, des organismes de (micro-) finance, de la société civile (ONG et associations), et des centres de recherche et de formation. Il aura pour missions : la définition de l'orientation, l'élaboration des stratégies, et le suivi du programme.

- **Technologie et renforcement de capacités**

Un accent particulier sera accordé à la qualité des installations et des services, afin de gagner la confiance du marché (bénéficiaires). Ceci implique la qualité de l'information, des constructions, des services après-vente et le système de certification des entreprises impliquées. Dans le même ordre d'idées, toutes les activités de formation, d'information et de sensibilisation devront être assurées à tous les niveaux pour favoriser une diffusion massive de la technologie dans le pays. Les instituts de recherche appliquée seront mis à contribution pour arriver à définir et à mettre en place des standards nationaux pour les unités de biogaz. Un mécanisme de suivi et évaluation, impliquant plusieurs acteurs d'horizons divers, sera développé à tous les niveaux pour suivre les réalisations, et contrôler la gestion du programme.

- **Finance et subvention**

Un mécanisme de financement raisonnable et accessible sera mis en place pour aider les ménages à supporter l'investissement initial pour l'acquisition des unités de biogaz. Ce mécanisme sera développé et assuré par les institutions financières, représentées localement comme le « Réseau des Caisses Populaires du Burkina » (RCPB). La mise en place d'un système de subventions sera un important instrument de marketing, devant être lié aux standards de qualité prédéfinis. Des subventions complémentaires devraient aussi être accordées pour supporter les coûts liés à la construction d'étables dallées et de toilettes ou latrines.

- **Commercialisation et marketing**

Pour assurer la construction des digesteurs et les services après-vente correspondants, la création d'entreprises locales devra être encouragée et soutenue. Ceci implique aussi le développement de l'entrepreneuriat auprès des techniciens en biogaz, par le renforcement de leurs capacités en gestion. La commercialisation doit être accompagnée et soutenue par une stratégie de marketing (publicité) établie sur le long terme.

- **Rôle de la GTZ/SNV**

De par son expérience dans ce secteur de développement, la GTZ/SNV assurera des services de renforcement de capacités à tous les niveaux, particulièrement en termes de développement institutionnel.

Executive Summary

Ever since the serious droughts of the 1970's, Burkina Faso has been developing strategies, action plans and programmes designed to restore a socio-economic and ecological balance, to ensure food self-sufficiency and to start a sustainable development process. Among the main political orientations addressing agricultural development, there are two objectives that apply directly to promoting and marketing of integrated biogas systems:

(1) the increase in productivity through the dissemination of intensive production technologies (including livestock for meat and milk production combined with fodder crop production, agro-forestry systems, composting of manure and agro-residues, rain fed agriculture, biogas application and fuel wood saving stoves);

(2) the fight against the deterioration of natural resources by focusing on measures in soil fertility and by giving more responsibility to grass-root actors and NGOs.

The country is also facing problems of overgrazing, soil degradation and deforestation[1].

Furthermore, due to increased urbanization in recent decades, services in sub-urban areas are collapsing under the weight of such rapid development, resulting in a dismal sanitation and household energy situation.

This rapid development has had negative impacts on both the quantity and quality of available water resources, public health and the environment. Water resources are being increasingly contaminated by industrial pollution, poor sanitation, discharges of untreated sewage and faecal sludge, and other anthropogenic factors.

The increased use of fuel wood, coupled with decreasing rainfall has accelerated deforestation. In the period 1990-2005, the area of forest and other wooded land decreased appreciatively by 350,000 hectares[2]. This trend appears to be continuing. According to the Ministère de l'Environnement et du Cadre de Vie, the deforestation rate is currently estimated to about 105,000 hectares per year. People from the affected zones are likely move to more favoured areas. Conflicts between sedentary farmers and pastoralists may increase as a result as will the urban population. Migration of dry land savannah farmers to the industrial crop areas may also increase.

Renewable energy is shifting from the fringe to the mainstream of sustainable development. Past donor efforts achieved modest results but often were not sustained or replicated, which leads now to greater market orientation. Markets for rural household lighting with solar home systems, biogas, and small hydro power have expanded through rural entrepreneurship, government programs, and donor assistance, serving millions of households. Applications in agriculture, small industry, and social services are emerging. Public programs resulted in 220 million improved biomass cook stoves. Three percent of power generation capacity is largely small hydro and biomass power, with rapid growth of wind power. Experience suggests the need for technical know-how transfer, new replicable business models, credit for rural households and entrepreneurs, regulatory frameworks and financing for private power developers, market facilitation organizations, donor assistance aimed at

[1] Country profiles http://www.theodora.com/wfbcurrent/
[2] http://www.fao.org/forestry/site/32185/en/

expanding sustainable markets, smarter subsidies, and greater attention to social benefits and income generation.[3]

Chapter 1 of the presented Feasibility Study resumes the current situation in Burkina Faso under social aspects, water and energy issues, agricultural and livestock sector activities, sanitation and, last but not least, environmental topics.

Chapter 2 is dedicated to the history of biogas technology in Burkina Faso, including research and implementation steps.

Chapter 3 analysis the technical feasibility of currently available biogas digester designs for standardization and massive dissemination in the context of Burkina Faso. Reviewing all potential client groups, the estimated total market size achieves more than 100.000 biogas plants to be build until 2030 (conservative scenario). Applying optimistic criteria for the estimation of the potential Biogas Market size, 200.000 plants could be in operation until 2030.

Chapter 4 presents the outline of a National Domestic Biogas Program. Within the four basic chapters of the program, potential partners and strategic alliances are presented; these long lists of supporters at any level of society demonstrate clearly that a National Biogas Program is more than requested. It includes a graph presentation of the expected impact chain.

Chapter 5 summarizes the conclusions, the international and inter-institutional Study Team has also discussed with the participants of the stakeholder workshop in April 2007 in Ouagadougou.

A second volume provides additional information as separated attachments which could be important for the implementation step of the programme - like maps, calculations, sketches, list of resource persons, institutions, bibliographical resources considered during the study, and pictures taken during the mission in 2007.

[3] Martinot, E. et al. RE Markets in Developing Countries, 2002

A) Introduction

The present document is based on the Terms of Reference (ToR) prepared by GTZ for a detailed study analysing the technical, economic, and socio-political feasibility of initiating a large-scale household biogas program including resource recovering sanitation systems in Burkina Faso.

The work is also based on GTZ's International experience with (1) economic development and capacity building in rural Africa, (2) dissemination of a range of renewable energy systems, improved cook stoves, and resource recovering sanitation systems in rural areas around the world, (3) experiences made with the design and implementation of small biogas projects under the past biogas dissemination projects in Africa, (4) the establishment of micro credit facilities in rural communities in developing countries, (5) valuation of social, agricultural and environmental benefits.

The objective of this study is to thoroughly assess the feasibility of establishing and implementing a national biogas programmes to meet energy, sanitation, health, environment and income needs.

B) Methodology

The present Feasibility Study has been carried out by an international, interdisciplinary team of experts in renewable energy and sanitation. A desk study and a three week mission to Burkina Faso provided basic and specific information which has been processed in this document.

After having studied available documents in Germany and on the internet, in-depth studies of biogas documentation in Burkina Faso have been carried out, resulting in "biogas archaeology" throughout the country. Several plants were visited during the study trip and former operators have been interviewed thus contributing to "lessons learned" and also to the outline of a potential biogas programme.

To support conclusions, opinions and experiences from stakeholders, interviewed in ministries and administration, with data gathered from potential biogas clients, a Rapid Household Survey has been undertaken in April 2007 addressing 100 rural and peri-urban households in Fada N'Gourma, Bogande and Gaoua. The households have been selected by chance in regions, where GTZ and the Government of Burkina Faso are implementing different programmes supportive to the integration of the agricultural and animal husbandry sector. The interviews have been conducted in the local languages. Apart from one wife and one son, only male household heads answered the structured questionnaire.

The information gathered in the interviews has been processed in a very schematic way, given the fact that the Rapid Household Survey will serve only as framework for baseline studies which should be carried out as soon as the NDBP-BF begins.

The first conclusions elaborated by the team were presented during a stakeholder workshop in Ouagadougou on April 27th 2007, where the Study Team received further comments on a potential National Domestic Biogas Programme. Fine tuning of the Feasibility Study has been executed after discussing the preliminary results with representatives of UEMOA and WINROCK International during the conference "Biogas for better life" in Nairobi, Kenya, on May 20 to 22nd, 2007.

A first draft study was established and delivered for comments to the GTZ contract partners on June 25th, and the final draft was established from July 4th to July 10th.

1 Background to Burkina Faso

1.1 General

Land area[4]:	274,200 km²
Population:	13,4 million in 2006[5], 82% live in rural areas[6]
Population growth rate:	2.9%[7]
Languages:	French, and about 60 different ethnic and local languages
Currency	Franc Communauté Financière d'Afrique (FCFA)
Fixed Exchange Rate to EUR	100 FCFA francs = 1 French (new) franc = 0.152449 EUR; 1 EUR = 655.957 FCFA

1.1.1 Geography

Burkina Faso is a landlocked country in West Africa sharing land boundaries with

- o Benin 306 km
- o Ivory Coast 584 km
- o Ghana 549 km
- o Mali 1,000 km
- o Niger 628 km
- o Togo 126 km.

The terrain is mainly flat with undulating plains, and hills in the West and South-East. The lowest point is Mouhoun River (Black Volta) with 200m above the sea level (asl) and the highest point is Tena Kourou with 749m asl.

1.1.2 Climate

As part of the Sahel zone the country is characterised by a generally semi-arid climate, with well-defined dry and rainy seasons. Rainfall ranges from 400 mm in the north to 1,300 mm in the south-west and there is a high variation between years. The water balance is negative throughout the country.

Three climatic zones can be distinguished[8]

- Southern Sudanian zone: south of latitude 11° 30´ N, divided into two regions, west and east of the Black Volta. In the western region, rainfall is generally over 1,000 mm, but may reach 1,300 to 1,400 mm, and the rainy season lasts

[4] Atlas de l'Afrique, 2005

[5] Census 2006

[6] GoBF 2006a

[7] Annuaire Statistique / Sante 2006

[8] http://www.fao.org/forestry/site/countryinfo/en/

five to six months. In the eastern region, rainfall is around 1,000 mm and the rainy season lasts four months.

- Northern Sudanian zone: largest part of the country. Annual rainfall ranges from 650 to 1,000 mm and the rainy season lasts four months, peaking markedly in August.
- Sahelian zone: north of latitude 14° N. Rainfall ranges from 500 mm to 600 mm and is spread over roughly three months (with 40 to 45 days of rain).

During the last few decades, the 400 mm isohyets rose up to the northern border of the country and the 1,100 mm isohyets reappeared in the south. This rainfall dynamic has implications for crop production and food security, as frequency and intensity of precipitation changed. Beyond the Sahelian zone, the dry land Sudanian savannah, which registers an average annual rainfall greater than 600 mm, has also experienced serious climate shocks, particularly droughts, since the early 1980s. Besides low averages in annual rainfall, inter-annual variability in precipitation and temperature is marked. During the warmest months (March, April and May), temperatures are permanently more than 40 °C. From November to February, average temperatures are between 25 and 30 °C. A declining trend in rainfall that started with repeated droughts in the 1980s is even more worrying[9].

Annual precipitation is low and can vary immensely. The volume over the last 40 years amounts to 207 billion m³, with 166 billion m³ evaporating, almost 9 billion m³ runs off and 4,8 billion m³ (falling to 2,3 billion m³ in bad years) recharge aquifers[10]. The calculated remaining 17 billion m³ can hardly satisfy the needs in agriculture and for drinking water supply.

1.2 Society

1.2.1 Demography

According to the most recent annual health statistics[11], the average density of population is about 46 inhabitants[12] per km^2. 52% of the total population are women. The annual population growth rate is estimated to about 2.9 %. Average household size is 5.84 in urban areas and 10 in rural areas[13].

a) Culture and social organization

There are over 60 ethnic groups in Burkina Faso. Each of them keeps specific cultural values and habits alive while certain commonalities can be applied across the country. This is partly due to history and to internal migration. A strict regional separation is no longer evident, although some significant differences can still be observed in architecture and habitat.

[9] Centre for Environmental Economics and Policy in Africa (CEEPA), University of Pretoria, South Africa, Climate Change and African Agriculture, Policy Note No. 36, 2006, Tel: +27 (0)12 420 4105, Fax: +27 (0)12 420 4958, Web address: www.ceepa.co.za

[10] MAHRH/PAGIRE: Etat des lieux des ressources en eaux au Burkina Faso et de leur cadre de gestion, 2001 -

[11] « Annuaire Statistique / Santé » 2006

[12] updated calculation: 48 persons/km^2

[13] Annuaire Statistique / Santé 2006

Table 1: Main ethnic groups

Ethnic	%
Mossi	48
Peul	10
Bobo	7
Lobi-Dagari	7
Mandé	7
Sénoufo	6

b) Religion

The census in 1960, 1991 and recent studies reveal remarkable changes in religious practices.

Table 2: Religions: development and regional distribution

Religion	Main Regions	1960/1961	1991	2005	2007[14]
Traditional religion	South West (up to 85%)	68.7	25.9	40.0	25%
Christians	Central	3.8	20.7	10.0	15%
Muslims:	North	27.5	52.4	50.0	60%

c) Household & family

Throughout the country, different types of household definitions have to be considered due to traditional cultural values, livelihood systems and religion.

Looking at the Mossi, Lobi and Dagara lands, the following definition may simplify the description of the system[15]: a household itself consists of husband, wife and children living under the same roof. Co-wifes and their children have their own houses, thus forming a "concession", a ring or square of houses around one yard. This "concession" represents the family, with the oldest man recognized as "Chef de Famille". Several big families living in different yards build a village; they are often interrelated by one common ancestor and thereby constitute a clan.

Table 3: Household size, an example from Poni Province

Household Members[16]	rural	Urban
1 person	3,8 %	11,4 %
2 – 5 persons	45,5 %	45,6 %
6 – 9 persons	32,3 %	29,3
10 and more persons	18,4 %	13,7 %

d) Women's role and position

Referring to household energy needs and supply, women and girls are key actors. Nevertheless, culturally and economically their daily work is considered as of secondary value [17], and a disproportionate share of household tasks and responsibilities lead to severe time constraints for women and girls. In addition, carrying up to 20% of their body weight in fuel wood on their head can provoke health problems such as headache and neck and back problems. The spine may become painfully distorted by carrying heavy loads.

[14] Atlas de l'Afrique 2005 & http://www.infoplease.com/ce6/world/A0857071.html
[15] Monographie de la Province du Poni, 2004
[16] Monographie de la Province du Poni, 2004
[17] F.B.T.R.D Les utilisations des moyens intermédiaires de transport au Burkina Faso, 1999

In the South West, women execute all agricultural activities on the fields of their fathers, brothers and husbands, without having the right to own land. The first wife often plays a role as adviser to the husband; and it is appreciated when a woman generates additional income by handicraft, trade and transformation of agricultural products.

Dagara women in the South-West do not own the stove they cook on; their husbands are responsible for its correct functioning. It is the husband's decision – after consultation with his first wife - if the wives should use one common kitchen or cooking area, if each wife has her own cooking space, or if food is prepared in rotation by each wife in turn.

Girls may get married from the age of 12 onwards, whereas countrywide the most common age for marriage is around 20.

e) Literacy & education

Programmes for literacy address people over 10 years; average literacy rates in the Poni province, as one pre-selected province for a potential biogas programme, is around 10.7%.[18]

Table 4: Education level

Education level	Women (%)	Men (%)
No formal education	48,10	44,34
Primary school	1,01	2,28
Secondary school	0,00	0,01
University	0	0,02

1.2.2 Political and administrative system

Implementation of NDPB will have to consider the recently implemented process of decentralisation which impacts on the economic and ecological plans at regional and provincial level: 13 administrative regions are divided into 45 Provinces. Among the 351 communes throughout the country 49 are counted as urban and 302 as rural. In addition to the capital Ouagadougou, other large cities include Bobo-Dioulasso, Koudougou, Kaya, and Ouahigouya.

Until the early 1990's Burkina Faso was very much a centralised state, with an institutional structure inherited from French colonialism. Decisions were taken at the centre and then executed at the local level via the political – administrative hierarchy.

In the last 15 years however, the country has been undergoing a process of decentralisation. Driven by an opening towards democratisation, the constitution of 1991 establishes Collectivités Territoriales (CTs) at regional and local level as the basic democratic and administrative entities. Throughout the 1990s, a number of laws were introduced to implement decentralisation of which the most recent is the "Code Géneral des Collectivités Territoriales" adopted in 2004.

This latest development in the decentralisation process establishes that local governments are juridical entities, which enjoy financial autonomy. They have replaced the former rural "départements" and urban municipalities by "communes", having the right to self-administration and to establish their own development plans according to locally set priorities. Both, urban and rural local governments will be

[18] Monographie de la Province du Poni, 2004

governed by the same rules. The first local government elections took place on 23rd April 2006.

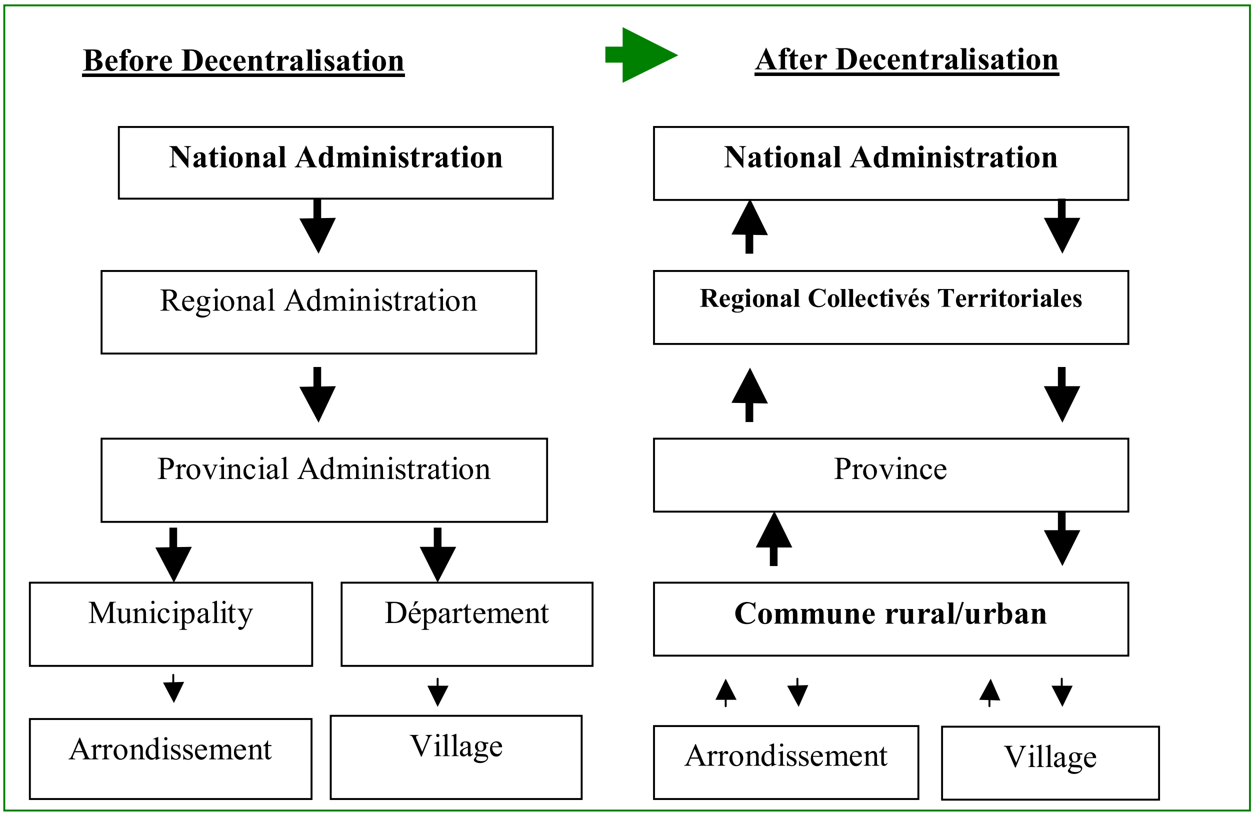


Figure 2: Administrative structure before and after decentralisation

While both mayors and parliamentarians are elected locally by the population for a period of 5 years (last legislative elections on May 6th 2007), representatives of the central government at regional and provincial level – Regional Governor, Provincial High Commissioner, and Departmental Prefect - are nominated by the government.

The decentralisation process envisages a "fast-track process" for the transfer of a number of core responsibilities to local governments. These responsibilities include sanitation, hygiene promotion and water supply. The overall transfer process from line ministries to local governments has already begun. However some difficulties have been experienced to loosen the central control over financial resources. Another bottleneck seems to be the transfer of human resources and competencies.

Traditional power also remains very important: for example, in the South West Region, the "Chef de Terre" ("Chief of the Earth") and the village community constitute the ultimate local power and decision maker.

1.2.3 Economy

The country's economy depends on subsistence agriculture representing 39.5% of GDP[19], cotton production, and regional trade[20]. At the national level, more than 90%

[19] Gross Domestic Product
[20] http://www.theodora.com/wfbcurrent/burkina_faso/burkina_faso_economy.html

of the population is engaged in agriculture and animal breeding[21]. But the most important source of national revenue is cotton.

Burkina Faso is making substantial progress in stabilizing and rehabilitating its economy. Result of these efforts is the implementation of numerous international projects carried out by various donors, but at the same time this means that a large part of the economic activity of the country is funded by international aid.

In January 2007, the general price level went down by 1.7% compared to December 2006. Inflation rate has been established at 0.3%. Prices for solid fuels have been reduced, while liquid fuels including kerosene did not vary[22].

Table 5: Price developments

	Average February 2005 to January 2006 (1)	Average February 2006 to January 2007 (2)	Variation (2)/(1) in %
Average price index in 12 months	124.2	126.3	1.7
Average price index in 12 months for housing, water, gas, electricity and other fuels	126.2	130.5	3.4

Table 6: Monthly price variation in January 2007

Energy product	-2.1%
Local products	-2.7%
Imported products	+0.8%

a) Employment

The low rate of employment has resulted in high emigration: 3 million Burkinabe live in Ivory Coast[23]. According to the Central Bank of Western African States[24], these migrants send tens of billions of FCFA back home each year. Since the 1967 expulsions from Ghana, this situation has periodically provoked tensions in the destination countries. The most recent crisis occurred in 2003 in Ivory Coast leading to the return of 300,000 migrants.

b) Industrial products

Industrial products are cotton lint, beverages, agricultural processed products, soap, textiles, and gold[25]. Mineral resources are scarce and limited to manganese, limestone, marble, small deposits of gold, phosphates, pumice, and salt.

[21] http://www.theodora.com/wfbcurrent/burkina_faso/burkina_faso_economy.html
[22] Commission de l'UEMOA: Indice des prix a la consommation au sein de l'UEMOA (janvier 2007), 2007
[23] Côte d'Ivoire
[24] Banque Centrale des États de l'Afrique de l'Ouest
[25] http://www.theodora.com/wfbcurrent/burkina_faso/burkina_faso_economy.html

c) Agro-Business

Agro-business, with food and agricultural processing units, is currently experiencing a boom and is strongly supported at national level by government. According to the Chamber of Commerce, Industry and Workmanship[26], 134 agro related Small and Medium Enterprises and Agro-Industries were registered in 2006[27]. The number of non-registered small associations involved in agro-industrial activities – for example food, shea butter, soap, and beverages production - is estimated at about 2,000.

To increase their performance and efficiency, small and medium sized transformation units are generally organised in the form of associative cooperatives, enabling some of them to attain a level of production appropriate for export. These increased agro-business activities could be linked to the development of medium and large scale farms which can be seen across the country.

d) Import – Export -Balance

The annual cost of Burkina Faso's imports is usually much higher than its earnings from exports; the nation relies on debt servicing from other countries.

Table 7: Import-Export-Balance 2005 [28]

Imports 2005	Exports 2005
US$ 395 million free on board: foodstuff, petroleum, and machinery	US$ 992 million free on board: cotton, peanuts, peanut oil, live animals, gold

1.2.4 Poverty analysis

a) Human Development Index

The Human Development Index (HDI) measures the average progress of a country in human development. According to the HDI, Burkina Faso is one of the poorest countries in the world, with more than 40% of the population living below the poverty line[29]. Poverty is most widespread in rural und peri-urban areas (51%)[30] and tends to affect women more than men.

Each year since 1990 the Human Development Report has published the human development index (HDI) that looks beyond GDP to a broader definition of well-being. The HDI provides a composite measure of three dimensions of human development:

- living a long and healthy life measured by life expectancy,
- being educated measured by adult literacy and enrolment at the primary, secondary and tertiary level
- having a decent standard of living measured by purchasing power parity, PPP, income.

---

[26] Chambre de Commerce, de l'Industrie et de l'Artisanat
[27] Chambre de Commerce, de l'Industrie et de l'Artisanat du Burkina Faso – Répertoire des entreprises agroalimentaires du Burkina Faso, 2006
[28] Chambre de Commerce, de l'industrie et de l'artisanat, Burkina Faso 2007
[29] Burkina Faso MDG Report 2003 http://www.undg.org/access-file.cfm?cat=79&doc=5197&file=6528
[30] FAO/Livestock information, Sector Analysis and Policy Branch (2005) – Livestock Sector Brief of Burkina Faso

The index is not in any sense a comprehensive measure of human development. It does not, for example, include important indicators such as gender inequality and difficult to measure indicators like respect for human rights and political freedoms. What it does provide is a broadened prism for viewing human progress and the complex relationship between income and well-being.

The HDI for Burkina Faso is 0.342, which gives Burkina Faso a rank of 174 out of 177 countries with data[31].

Table 8: Socio-economic indicators

HDI value	**Life expectancy at birth** *(years)*	**Adult literacy rate** *(%; ages 15 and older)*	**Combined primary, secondary and tertiary gross enrolment ratio** *(%)*	**GDP per capita** *(PPP US$)*
1. Norway (0.965)	1. Japan (82.2)	1. Georgia (100.0)	1. Australia (113.2)	1. Luxembourg (69,961)
172. Central African Republic (0.353)	150. Uganda (48.4)	125. Niger (28.7)	167. Central African Republic (29.8)	151. São Tomé and Principe (1,231)
174. Burkina Faso (0.342)	152. Burkina Faso (47.9)	127. Burkina Faso (21.8)	169. Burkina Faso (26.4)	153. Burkina Faso (1,169)

By looking at some of the most fundamental aspects of people's lives and opportunities the HDI provides a much more complete picture of a country's development than other indicators, such as GDP per capita. Countries on the same level of HDI as Burkina Faso can have very different levels of income and life expectancy.

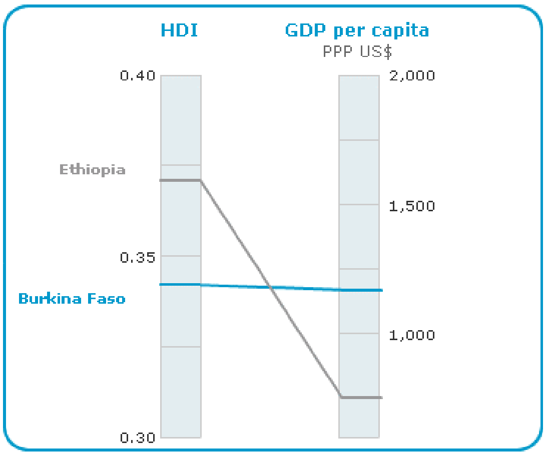


Figure 1: HDI and GDP ranking for Burkina Faso compared to Ethiopia [32]

[31] UNDP 2006 Human Development Report http://hdr.undp.org/hdr2006/statistics/countries/data_sheets/cty_ds_MWI.html

[32] UNDP 2006 Human Development Report http://hdr.undp.org/hdr2006/statistics/countries/data_sheets/cty_ds_MWI.html

b) Human Poverty Index

The Human Poverty Index for developing countries (HPI-1) focuses on the proportion of people below a threshold level in the same dimensions of human development as the human development index. By looking beyond income deprivation, the HPI-1 represents a multi-dimensional alternative to the $1 a day (PPP US$) poverty measure.

The HPI-1 measures severe deprivation in health by the proportion of people who are not expected to survive age 40. Education is measured by the adult illiteracy rate and a decent standard of living is measured by the unweighted average of people without access to an improved water source and the proportion of children under age 5 who are underweight for their age.

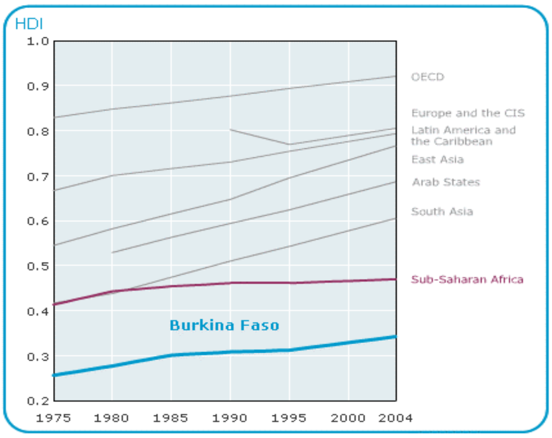


Figure 2: Comparison of Human Poverty Index development since 1975[33]

The HPI-1 value of 58.3 ranks Burkina Faso on place 101 among 102 developing countries for which the index has been calculated[34].

Table 9: Selected indicators of human poverty, situation 2004

Human Poverty Index (HPI-1)	**Probability of not surviving the age 40** *(%)*	**Adult illiteracy rate** *(%) (ages 15 and older)*	**People without access to improved water and sanitation** *(%)*	**Children underweight for age** *(%) (ages 0 – 5)*
1. Uruguay (3.3)	1. Hong Kong, China (SAR) (1.5)	1. Cuba (0.2)	1. Bulgaria (1)	1. Chile (1)
100. Chad (57.9)	145. Mali (37.3)	115. Chad (74.3)	96. Kenya (39)	121. Pakistan (38)
101. Burkina Faso (58.3)	146. Burkina Faso (38.9)	116. Burkina Faso (78.2)	97. Burkina Faso (39)	122. Burkina Faso (38)

c) Poverty & Gender equity

The HDI measures average achievements in a country, but it does not incorporate the degree of gender imbalance in these achievements. The gender-related

[33] UNDP 2006 Human Development Report http://hdr.undp.org/hdr2006/statistics/countries/data_sheets/cty_ds_MWI.html
[34] UNDP 2006 Human Development Report http://hdr.undp.org/hdr2006/statistics/countries/data_sheets/cty_ds_MWI.html

development index (GDI), introduced in Human Development Report 1995, measures achievements in the same dimensions using the same indicators as the HDI but captures inequalities between women and men. The greater the gender disparity in basic human development, the lower is a country's GDI relative to its HDI.

Burkina Faso's GDI value of 0.335 should be compared to its HDI value of 0.342. Its GDI value is 98.0% of its HDI value. Out of the 136 countries with both HDI and GDI values, 109 countries have a better ratio than Burkina Faso[35].

Table 10: GDI compared to the HDI – a measure of gender disparity, situation 2004

GDI as % of HDI	**Life expectancy at birth** *(years)* ***Female as % male***	**Adult literacy rate** *(% ages 15 and older)* ***Female as % male***	**Combined primary, secondary and tertiary gross enrolment ratio** ***Female as % male***
1. Luxembourg (100.4 %)	1. Russian Federation (122.4 %)	1. Lesotho (122.5 %)	1. United Arab Emirates (126.0 %)
109. Algeria (98.0 %)	162. São Tomé and Principe (103.3 %)	107. Sierra Leone (52.0 %)	171. Iraq (76.2 %)
110. Burkina Faso (98.0 %)	163. Burkina Faso (103.1 %)	108. Burkina Faso (51.7 %)	172. Burkina Faso (75.4 %)

1.3 Water

1.3.1 Water resources

Open water resources represent a surface of about 400 km^2. The country is drained to the south by the Black Volta (Mouhoun), Red Volta (Nazinon), and White Volta (Nakanbe) rivers and to the east by the Sirba, Gorki and Mahiou rivers connecting with the Niger. The Niger River basin drains 27% of the country's surface. Its tributaries - Béli, Gorouol, Goudébo and Dargol rivers - are seasonal streams and only flow for 4 to 6 months a year, but can cause large floods.

Numerous lakes, large ponds and a swampy region in the south-east add to the country's water resources. Furthermore, besides the natural wetlands of varying types including floodplains, lakes and marshes, there were some 1,100 dams or embankments each of which has created an artificial wetland. A continuous decrease in precipitation since the 1970's, coupled with an increasing water demand led to the construction of these dams or embankments to retain rainwater. The resulting artificial surface water plays a considerable role in the water supply for local populations and animals. Some of these facilities are also used as small hydro-electric power plants like in Niofila and Tourny, the Leraba province. However, during the dry season, many of these reservoirs dry up, due to the frequent water withdrawal and high evapotranspiration.

The volume of available water resources is strongly influenced by unfavourable natural and demographic boundary conditions. Groundwater levels across the country have been decreasing over the past 30 years. In 1998 the available water volume per person per year was estimated at 1,750 m³, however a revision of this figure in 2001 lead to a drastic reduction to 852 m³/cap/year, making Burkina Faso a water scarce country.

[35] http://hdr.undp.org/hdr2006/statistics/countries/country_fact_sheets/cty_fs_BFA.html

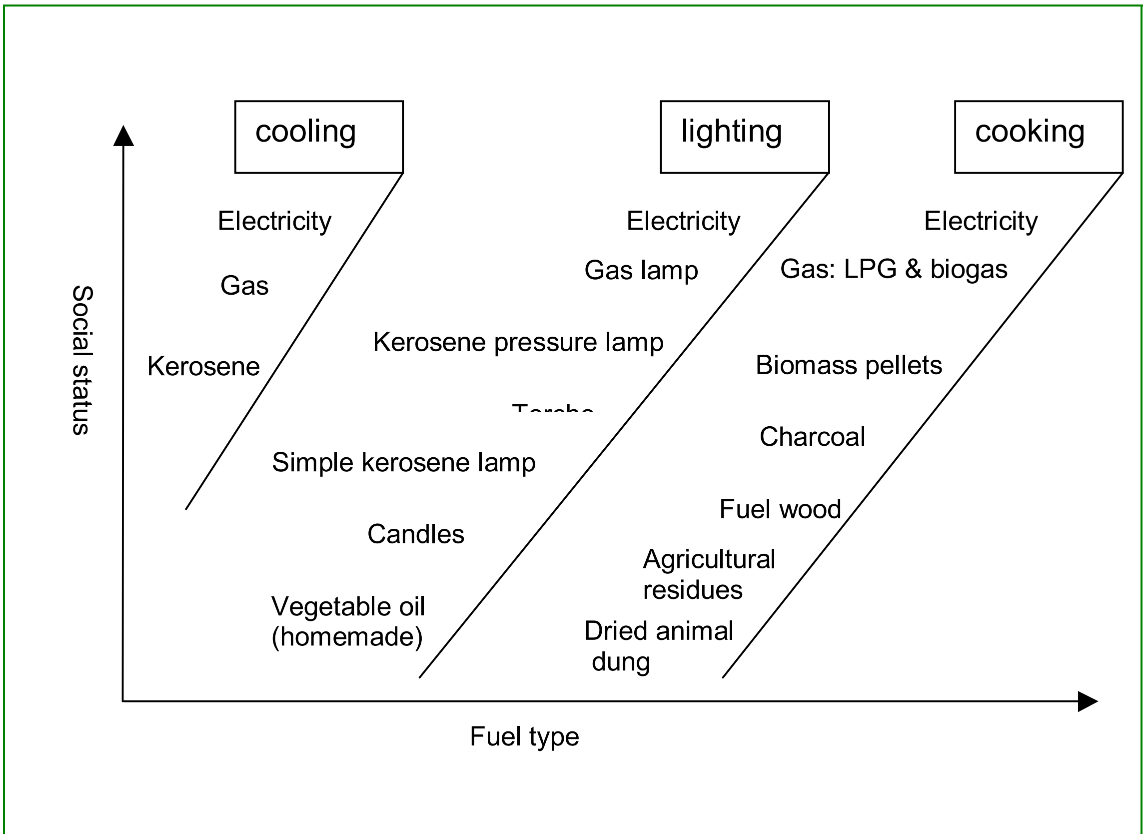
1.3.2 Water Sector Services

In urban areas with populations of over 10,000, drinking water supply and sanitation services is generally the responsibility of ONEA[36], the national water office. Coverage of drinking water supply is estimated at 74%, with 40% of the population using public standpipes and 34% with individual household connections. In order to increase access to water, numerous modern water points have been constructed throughout the country by national and/or international initiatives, programs or projects.

In rural areas, 27,000 bore-holes and 7,300 modern wells are actually in operation. These water facilities are reinforced by 311 functioning small water networks with fountain systems. In 2005, 60% of rural population had access to drinking water[37][38]. The National Programme for Drinking Water Supply and Sanitation 2015[39] aims to achieve drinking water coverage of 80% in rural areas with 20 l/inhabitant/day, and 87% in urban areas with 50 l/inhabitant/day by 2015.

1.4 Energy

Sustainable energy provision is another major challenge. As in other countries in West Africa, energy supplies are utterly inadequate in terms of achieving sustainable development objectives.



[36] Office National de l'Eau et de l'Assainissement
[37] Direction Générale des Ressources en Eau / Ministère de l'Agriculture, de l'Hydraulique et des ressources Halieutiques (2006) – Programme National d'Approvisionnement en Eau Potable et d'Assainissement à l'horizon 2015
[38] Joint Monitoring Programme (JMP) Report 2006 http://www.wssinfo.org/en/40_mdg2006.html
[39] Programme National d'Approvisionnement en Eau Potable et d'Assainissement à l'horizon 2015

Figure 3: Household fuel energy ladders

Energy services (e.g. for light, heat, mechanical power, telecommunications) can be generated from conventional or renewable energy. The quality, reliability and affordability of the services are what matter from a human development point of view[40].

1.4.1 Energy policies[41]

Energy sources include the following:

- Hydrocarbons imported at 100%
- Thermal and hydro power for electricity generation
- Solar and wind energy
- Fuel wood

Firewood remains the most important energy resource for the country not only at household level, but also for restaurants, for the preparation of the famous “dolo”, the traditional millet beer, and for bread production. Data for firewood use per capita vary between 0.7kg (GTZ) and 1.2kg (FAO). Results from the Rapid Household Survey during the Feasibility Study tend to support the FAO results: including also the family based beer production the surveyed households use an average of 1.1 kg firewood/cap/d. The beer production counts for about 15% of the firewood demand, meat grills (brochette) for at least another 5%.

LPG use is still limited. Gas is considered as being slightly dangerous by some people, and distribution channels have barely reached rural areas.

Since the eighties the substitution of fuel wood for cooking through the market development of kerosene stoves has been foreseen by energy experts. However steadily increasing prices for all petroleum products have prevented this. Nowadays, kerosene is mainly used for lighting.

The use of charcoal is limited, as the government stopped about six years ago the uncontrolled production of charcoal, and introduced training and control of “professional” charcoal producers.

The fuel wood imbalance has been recognized as a challenge for rural development and the energy situation of the whole country for more than 20 years. Fighting against desertification at the same time as establishing energy access equity the government has put in place several measures:

- Large reforestation programmes
- Dissemination of improved stoves
- Promotion of LPG by tax reduction for gas equipment and also a subsidy for gas consumption
- Local nature recovery activities with village population.

All these actions have been accompanied by legal and political measures in the sectors concerned: forestry, agriculture, and environment, decentralization of administrative structures and financial decision making, energy.

[40] Yager, A., UNDP: The Role of Cleaner Fuels in Poverty Reduction, 2006
[41] CILSS Strategie energie doemstique du Burkina Faso, 2006

Today, the energy policy aims to achieve the following objectives:

- Reduce the import bills for hydrocarbons by diversification, substitution and energy efficiency
- Reduce pressure on natural forest resources
- Improve the institutional and legislative framework
- Increase electricity coverage in towns and villages and improve the general situation in the countryside by providing energy services
- Improve involvement of socio-economic aspects
- Increase the electricity offer
- Develop energy efficiency programmes
- Develop the national energy supply in a sustainable and affordable way
- Promote and disseminate new energy technologies

Since December 2000, the energy policy is been defined and developed along 4 axes:

1. improvement of the fuel wood offer through sustainable, participatory and decentralised management methods for natural resources
2. promotion of substitution fuels such as kerosene and LPG
3. awareness raising campaigns to promote the use of fuel wood / charcoal saving stoves
4. structuring and liberalising the energy market.

1.4.2 Electricity from SONABEL

According to data from the national electricity provider SONABEL, Burkina Faso produced about 549 GWh of electricity, and imported more than 139 GWh[42] in 2006. Electricity production is essentially from thermal and hydro-electric plants. With regard to the number of consumers and electrified localities, the electricity consumption of 32 KWh[43] per capita remains low. Electricity prices have been increasing continuously. The production cost per KWh in 2006 was 121.21 FCFA – corresponding to 18.5 EUR-Cent. Electricity provided by SONABEL is therefore unaffordable for the majority of the population.

Moreover, the electrification rate is about 15%, - 3% in rural areas[44]. 95% of available electricity is consumed in urban areas, while electricity needs in peri-urban and rural areas remain uncovered.

At household level in peri-urban and rural areas, energy demand focussing on cooking and lighting energy needs is essentially met using solid biomass, mainly fuel wood. Wood, charcoal and agricultural wastes account for between 52% and 90% of final energy consumption[45].

[42] SONABEL http://www.sonabel.bf/statist/chiff_caract.htm
[43] UNDP 2006 Human Development Report http://hdr.undp.org/hdr2006/statistics/countries
[44] Missions économiques/Fiches de synthèse (2006) – L'électricité au Burkina Faso
[45] ENDA TM (2005) The role of renewable energy in the development of productive activities in rural West Africa: the case of Senegal

According to the Ministry of Energy, national policies and plans should achieve a national electrification rate of 30% by 2010[46].

Table 11: Electricity network data[47]

Items	2003	2004	2005	2006
Electric network Low Voltage (m)	4,392,713	4,649,575	4,891,625	5,297,093
Electric network High Voltage (m)	1,371,567	1,503,856	1,622,774	1,817,680
Imported Energy (kWh)	69,149,845	96,183,557	125,337,589	139,323,910
Thermal production (kWh)	348,662,462	371,789,678	415,751,943	467,728,921
Hydro-electric production (kWh)	95,891,670	101,458,980	100,472,905	80,668,451
Number of consumers (Medium Voltage)	666	738	747	797
Number of consumers (Low Voltage)	226,025	234,389	255,039	283,908
Average kWh production cost (FCFA)	91.37	113.19	117.89	121.21
Number of thermal power plants	30	30	30	29
Number of hydro-electric power plants	4	4	04	4
Number of localities with electricity	53	56	62	64

1.4.3 Renewable energies

a) Solar Energy

The concept of renewable energies is currently limited to the use of fuel wood, although some national and international research programmes are investigating the use of solar energy. The follow up and the further development of Renewable Energy Technologies are only marginally supported by the government, despite significant potential. Like neighbouring countries in the West Africa region, Burkina Faso enjoys abundant sunshine during 3,000 hours per year and an average irradiation of 4.5 to 6 KWh/m²/day.

b) Energy from Biomass

Given the annual production volume of municipal organic waste and agricultural waste, the concept of energy production from biomass presents a high potential, which has yet to be fully explored. While composting of organic wastes, actually supported by a national program, is applied in small units by farmers, the anaerobic treatment of organic residues is not. Recognition of the potential is however present at various levels throughout the country, and further investigation would be welcomed and supported. This would not only result in providing a renewable energy source to poorer households but also in job creation, and could add value to the national economy, thus contributing to poverty reduction.

[46] Le FasoNet : http://www.lefaso.net/article.php3?id_article=8117
[47] SONABEL http://www.sonabel.bf/statist/chiff_caract.htm

c) Hydro & Wind Power

The hydro-electric potential is still under-exploited, although several dams for hydro power generation were built in the 1990s. Wind patterns could possibly be harnessed for both pumping and electricity generation, but no further R&D has been undertaken.

1.5 Agriculture

Three different farming systems are mainly practised:

- the root crop system, representing an area of 1,626 km^2 in the south-west,
- the mixed cereal - root crop system, representing a vast swathe of 180,970 km² across the south and centre of the country,
- the Agro-pastoral millet/sorghum system, representing 92,105 km^2 in the dry north[48].

Agricultural land currently represents about 38 % of the total national surface area[49], while the area of land under pasture is estimated to about 60,000 km^2. Arable land represents 17.66% of land use, permanent crops 0.22% and other 82.12%[50]. In 2003, the irrigated land was estimated to 250 km^2, although less than 10% of the land is cultivable without irrigation. Droughts have further limited agricultural production.

Agricultural activities are generally associated with livestock breeding, and concentrated in both rural and peri-urban settlement areas, often performed by women. Activities are very heterogeneous[51]; ranging from small-scale but capital-intensive market-oriented commercial vegetable growing, dairy farming and livestock fattening, and part-time farming by the urban poor to cover part of their subsistence requirements.

1.5.1 Agricultural activities and products

Agricultural activities, which consist mainly of large crop production, are diversified because they are strongly linked to the spatial and temporal variability of the climate and the rainfall. The changing climate and growing demand for natural resources by an increasing population compromise the sustainability of the current system of land use and seriously threaten food security among rural populations.

The main agricultural products are cotton, peanuts, shea nuts, sesame, sorghum, millet, corn, and rice.

Table 12: Cereal production in tons (x 1000)[52]

	2003 - 2004	2004 - 2005	2005 - 2006
Millet	1,184.3	937.6	1,196.3

[48] FAO Country profiles http://www.fao.org/countryprofiles/maps.asp?iso3=BFA&lang=en

[49] FAO/Livestock information, Sector Analysis and Policy Branch (2005) – Livestock Sector Brief of Burkina Faso

[50] http://www.theodora.com/wfbcurrent/burkina_faso/burkina_faso_economy.html

[51] FAO (2001) Global Farming Systems Study: Challenges and Priorities to 2030, REGIONAL ANALYSIS- SUB-SAHARAN AFRICA (http://www.fao.org/ag/magazine/GFSS-Afr.pdf)

[52] Missions économiques/Fiches de synthèse (2006) – Situation de l'agriculture au Burkina Faso

Sorghum	1,610.3	1,399.3	1,552.9
Maize	733.5	505.6	799.0
Rice Paddy	95.5	74.5	93.5
Fonio	8.7	9.1	7.8
Total	**3,632.3**	**2,926.1**	**3,649.5**

While production fluctuations have occurred for cereal, cotton production has increased by 500% in the last 10 last years[53], making Burkina Faso the largest cotton producer in Sub-Saharan Africa.

Table 13: Cotton production[54]

Year	Cotton seed (x 1,000 Tons)	Area (x 1,000 ha)	Yield (T/ha)	Price (1st Choice)
1995 - 1996	147.0	170.0	0.885	140
1996 - 1997	214.4	195.7	1.095	160
1997 - 1998	338.1	295.2	1.145	160
1998 - 1999	284.4	355.4	0.800	160
1999 - 2000	254.2	245.0	1.038	160
2000 - 2001	276.0	260.0	1.061	160
2001 - 2002	378.4	361.2	1.048	175
2002 - 2003	406.0	403.6	1.006	175
2003 - 2004	483.4	464.3	1.041	175
2004 - 2005	641.8	573.6	1.119	210
2005 - 2006	750.0	670.2	1.119	175

1.5.2 Fertilizer use

The soils are generally poor in terms of nutrients and organic matter. Massive degradation of soils constitutes another threat to agricultural production, and excessive runoff and low infiltration reduce the effectiveness of rainfall and increases water stress.

To improve soil quality and fertility, the excreta of domestic animals and organic waste are often composted on-site and used in market gardening. In response to their increasing needs in fertilisers or for soil conditioning, small holder farmers also buy compost produced from horse and cow excrements and sold by the wagon-load. Crop-livestock integration is promoted, but still not very common. Household animal breeding, whilst illegal in urban and peri-urban areas, generally comprises poultry, sheep, and goats in a sort of stable, which is cleaned once or twice per week.

In heavily urbanised areas, such as in the capital, the use of untreated faecal sludge from latrine pits and septic tanks is also practiced, with drivers of vacuum trucks being paid to empty their tanks on fields or gardens.

In 2002, the annual fertiliser consumption in 2002 was 1,671 Tonnes of N, P_2O_5, K_2O[55]. However the misuse of chemical fertilisers may lead to problems of long term soil fertility and possibly the eutrophication of neighbouring water resources. The heavy reliance of the agricultural sector on cotton production may very well increase both these risks. Even under good management conditions, the use of fertilisers may not be financially viable, particularly for those farmers growing food crops or in

[53] Missions économiques/Fiches de synthèse (2006) – Situation de l'agriculture au Burkina Faso
[54] Missions économiques/Fiches de synthèse (2006) – Situation de l'agriculture au Burkina Faso
[55] FAO Country profiles http://www.fao.org/countryprofiles

remote areas where the fertiliser prices are excessively high due to transport and handling costs[56].

Farmers producing cotton as a cash crop have an improved access to fertilisers through the national cotton industry who offer advance loans on production for agricultural inputs. Even if profitable, small farmers may not be able to afford chemical fertilisers.

In the absence of nutrient recapitalisation, soil productivity will degrade, even under good land husbandry practices, resulting in further poverty and increased food supply problems. Thus, there is a need to explore avenues through which resource-poor farmers can access fertilisers, and ensure their productivity and profitability by improving land and crop husbandry.

1.6 Livestock systems

According to the Ministry of Livestock Resources[57] more than 80% of Burkinabé are involved in livestock husbandry, organized in 1,700 breeder associations[58] and specialized organisations poultry, pig fattening and dairy cows[59 60] often, these associations maintain community "corrals" for commercial livestock breeding or dairy farming near water holes. There number is estimated by the governmental livestock experts at about 7,000 regrouped breeding groups with semi-permanent stabling (corrals) at least over night.

While nomadic livestock production still accounts for over 70% especially of the country's northern cattle[61], sedentary livestock farming with paddocks and feed production has been successfully established over the last few years, supported by national programmes particularly in the Eastern Region (e.g. Programme Développement Agricole supported by Germany) and increased the number of semi-intensive and intensive dairy and/or fattening farms. According to the dairy cooperative of Gourma, the number of small holder dairy farmers rose from 100 in 2003 to 400 in 2007.

To support their cultivation activities, an increasing number of households have 2 to 3 cattle or ox for animal traction. Donkeys are also used for transportation in the centre and north of the country. The livestock is generally fed and maintained in a paddock, close to the home. The animal dung is recognized as a valuable organic fertilizer and therefore composted in a constructed sealed compost pit. These compost pits may require for the decomposition process up to 200 litres of water per week, usually transported by donkey carts.

Table 14: Livestock population and annual growth rate[62] - national statistics

Items	cattle	sheep	goat	donkey	horse	camel	pig	chicken	guinea fowl

[56] FAO (2001) Global Farming Systems Study: Challenges and Priorities to 2030, REGIONAL ANALYSIS- SUB-SAHARAN AFRICA (http://www.fao.org/ag/magazine/GFSS-Afr.pdf)
[57] Ministère des Ressources Animales
[58] groupements d'éleveurs
[59] "Maison de l'Aviculture", "Maison des Eleveurs de Porcs", "Table filière lait" :
[60] Direction des Etudes et de la Planification/Ministère des Ressources Animales (2005) - Les Statistiques du secteur de l'Elevage au Burkina Faso
[61] FAO/Livestock information, Sector Analysis and Policy Branch (2005) – Livestock Sector Brief of Burkina Faso;
[62] FAO/Livestock information, Sector Analysis and Policy Branch (2005) – Livestock Sector Brief of Burkina Faso

Number* (x 1000)	7,607	7,110	10,647	951	36	15	1,963	25,868	6,490
Annual population growth rate**	4,7%	2,3%	3,3%	6%	-	-	10%	4,5%	

** Estimated number in 2005*
*** Average annual growth rate, calculated for the period 1989-2003*

Animal husbandry in transhumance, particularly of cattle, sheep and goats is the main economic activity of the Peuhl, a nomadic ethnic group in the north of Burkina Faso. This activity is complicated by long dry seasons, which obliges herdsmen to steer their herds of more than 100 animals southward towards greener pastures and water.

The high pig population growth rate could be explained by the increased number of fattening farms. The highest rates with 20-50 animals per km² are to be found in the centre of the country where the mixed cereal-root crop agricultural system is practised[63].

1.7 Natural resources and Environment

Ever since the serious droughts of the 1970's, Burkina Faso has been developing strategies, action plans and programmes designed to restore a socio-economic and ecological balance, to ensure food self-sufficiency and to start a sustainable development process. The fight against the deterioration of natural resources by focusing on measures to maintain soil fertility and by giving more responsibility to grass roots actors and NGOs includes strategies to solve environmental problems such as overgrazing, soil degradation and deforestation[64].

a) Deforestation

The increased use of fuel wood, coupled with decreasing rainfall has accelerated deforestation. For the period 1990-2005, the area of forest and other wooded land decreased appreciatively by 350,000 hectares[65]. According to the Ministry for Environment and Livelihood[66], the deforestation rate is currently estimated at 105,000 hectares per year. The decline in forest area is expected to continue. Managed forest remains low in percentage compared to the deforested areas[67], especially as reforested trees allow a first harvest for fuel wood only from the seventh year on[68].

People from the affected zones are likely move to more favoured areas. Conflicts between sedentary farmers and pastoralists may increase as a result as will the urban population. Migration of dry land savannah farmers to the industrial crop areas may also increase.

---

[63] FAO Country profiles http://www.fao.org/countryprofiles/maps.asp?iso3=BFA&lang=en
[64] Country profiles http://www.theodora.com/wfbcurrent/
[65] http://www.fao.org/forestry/site/32185/en/
[66] Ministère de l'Environnement et du Cadre de Vie
[67] FAO & Commission Européenne Direction Générale VIII Développement : Revue et amélioration des données relatives aux produits forestiers au Burkina Faso, 2000
[68] FAO & Unasylva No. 133 – Le bois source d'énergie – Edition spéciale 2: Une ville d'Afrique à court combustible, by Henri Chauvin, 1980

Due to accelerating urbanization in recent decades, services in peri-urban areas are collapsing under the weight of rapid development, resulting in an uncontrolled sanitation and household energy situation. Human actions produced negative impacts on the water resources, health and environment. The contamination of water resources is further increasing due to industrial pollution, poor sanitation practices, discharges of untreated sewage and faecal sludge.

It is obvious that various factors have already led to an ecologically critical situation which has to be tackled as soon as possible:

- progressing desertification due to unlimited deforestation,
- environmental pollution through unlimited waste discharge,
- fly and vector breeding through uncontrolled waste water discharge,
- uncontrolled GHG production through transhumance livestock management.

b) GHG emissions

In 1998, the total CO_2 emissions in Burkina Faso were estimated at 1,009 thousand metric tons of CO_2[69]. But based on the statistical data on livestock only, the amount of CO_2 emission equivalent at 1997 already reached 4326 Gg/y[70] emitted by 18.5 Mio animals. In 2005, as livestock has increased significantly to 26.4 Mio heads, CO_2 emission equivalent amounts to 6119 Gg/y[71].

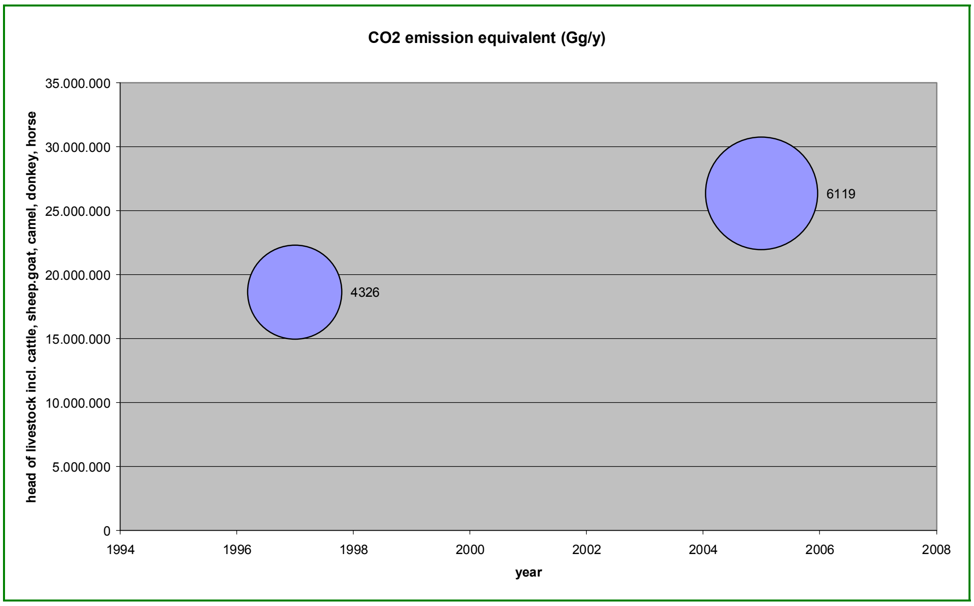


Figure 4: Development of CO_2 emission equivalent during the past decade

1.8 Health and sanitation

Water-related diseases are widespread, leading to illness and death of thousands of persons per year, particularly children under the age of 5[72]. Climate variability also

[69] http://earthtrends.wri.org/pdf_library/country_profiles/cli_cou_854.PDF
[70] Gigagram per year
[71] calculation based on livestock statistics and international reference data
[72] Synthesis of the 4th World Water Forum, 2006

increases vector-borne disease outbreaks and the incidence of diarrhoeal disease in the rainy season[73]. Malaria remains, at 46% in 2005, the main cause of death[74].

1.8.1 Health

Mortality among the under-fives and the percentage of undernourished people remains high, despite progress realized as part of the Plan National de Développement Sanitaire for 2001-2010. This progress concerns mainly improving access to health centres (CSPS) as the basic health structure, and the reduction of the national HIV infection rate from 7.17% in 1997 to 2% in 2005[75]. Based on the results of the last national surveys on household living conditions, the annual average expenditure per household for health care is estimated at more than 80,000 FCFA in urban areas and at less than 30,000 FCFA per year in rural areas[76].

Table 15: Health, water and sanitation indicators

Country	**Under-five mortality rate** *(per 1,000 live births)*[77], **2004**	**People undernourished** *(% of total population)*[78], **2001-03**	**HIV prevalence** *(% ages 15-49)*[79] **2005**	**Improved Drinking Water Coverage** *(%*[80]*)* **2004**			**Improved Sanitation Coverage** *(%)*[81], **2004**		
				T	U	R	T	U	R
Burkina Faso	194	17	2	61	74	54	13	42	6
Sub-Saharan Africa	-	-	-	56	80	42	37	53	28
Global	-	-	-	83	95	73	59	80	38
Required coverage[82]									
in 2004	-	-	-	65	-	-	52	-	-
for 2015	-	-	-	75	-	-	66	-	-

T: total; U: urban; and R: rural

1.8.2 Sanitation

In general, peri-urban and rural areas are not at all or only poorly equipped with water and sanitation services. Whilst some progress has been made regarding access to drinking water, low sanitation provision remains a major challenge.

The most common form of domestic wastewater and excreta management are on-site sanitation installations (i.e. pit latrines, VIPs or one chamber septic tanks with

[73] WWAP, 2006, The 2nd UN World Water Development Report: 'Water, a shared responsibility'
[74] Direction des Etudes et de la Planification - Ministère de la Santé (2006) Annuaire Statistique / Santé
[75] Direction des Etudes et de la Planification - Ministère de la Santé (2006) Annuaire Statistique / Santé
[76] Direction des Etudes et de la Planification - Ministère de la Santé (2006) Annuaire Statistique / Santé
[77] UNDP 2006 Human Development Report http://hdr.undp.org/hdr2006/statistics/countries
[78] UNDP 2006 Human Development Report http://hdr.undp.org/hdr2006/statistics/countries
[79] UNDP 2006 Human Development Report http://hdr.undp.org/hdr2006/statistics/countries
[80] Joint Monitoring Programme (JMP) Report 2006 http://www.wssinfo.org/en/40_mdg2006.html
[81] Joint Monitoring Programme (JMP) Report 2006 http://www.wssinfo.org/en/40_mdg2006.html
[82] Required coverage for Sub-Saharan Africa countries to be on track to reach MGD, according JMP

soak away). About 10% of the population has access to basic sanitation services, i.e. sanitation installations in their household.

The sanitation MDG was not even addressed in Burkina's MDG report 2003[83]. Several factors seem to contribute to this abysmal sanitation coverage: low incomes and the relatively low priority given to sanitation results in households rarely investing in toilets, whilst an unclear distribution of roles and responsibilities has lead to inactivity at the institutional level.

Several authorities and institutions have a mandate to intervene in wastewater, excreta and solid waste management with little or no coordination of activities. For example in urban areas, communes may be responsible for the management of solid waste and faecal sludge from septic tanks, whilst the national water supplier, ONEA, may have the responsibility for sanitation services in the same area. In rural areas this responsibility goes to the Direction de l'Assainissement, based since January 2007 in the Ministry for Agriculture and Water resources. At the same time the Ministry of Health, the Ministry of the Environment and Livelihood, the Ministry of Territorial Administration and Decentralisation, the Ministry of Education and the Ministry of Infrastructure, Transport and Habitat also have a mandate to intervene in sanitation. The result is institutional confusion and ultimately paralysis.

According to the Joint Monitoring Programme (JMP) report 2006 of UNICEF/WHO, Burkina Faso is not on track to reach the MDGs on water and sanitation. To bridge the gap in sanitation, new policies and plans have been drawn up in the *Programme National d'Approvisionnement en Eau Potable et d'Assainissement à l'horizon 2015*. According to this programme, the national objective for sanitation coverage achieves 54% or 5.7 million people to be provided with adequate sanitation facilities in rural areas, and 57 % or 2.1 million people in urban areas by 2015[84]. This coverage rate is however lower than the global target fixed by the MDG.

1.8.3 Sustainable Sanitation

In addition to the initiatives now being seized at governmental level to address the low sanitation coverage, several initiatives have started to introduce ecological sanitation systems.

In its regional sanitation programme, CREPA, the West-African Regional Centre for low-cost Water Supply and Sanitation has introduced ecological sanitation concepts. Two toilet types have been constructed and tested; the reuse of urine and faeces in agriculture, and the resulting health and socio-economic impacts have been investigated.

A comprehensive feasibility study on ecological sanitation in Ouagadougou was carried out for ONEA in 2004. The results of the study have led to a large scale implementation programme for Ouagadougou on 2006, with project partners including ONEA, CREPA, GTZ and municipal authorities. The project is co-financed by the European Union and aims to serve and raise awareness among up to 300,000 people.

The European Commission within the 6th Framework has funded NETSSAF, a Coordination Action which started in June 2006. Within 2.5 years the proposed network aims to create an enabling environment for a large scale implementation of

[83] Burkina Faso MDG Report 2003 http://www.undg.org/access-file.cfm?cat=79&doc=5197&file=6528

[84] Direction Générale des Ressources en Eau / Ministère de l'Agriculture, de l'Hydraulique et des ressources Halieutiques (2006) – Programme National d'Approvisionnement en Eau Potable et d'Assainissement à l'horizon 2015

sustainable sanitation systems in West Africa, including Burkina Faso, to develop a variety of innovative, adaptable and replicable approaches to sustainable sanitation and to integrate appropriate low-cost technologies with community-based management.

2 Biogas in Burkina Faso

2.1 History

Experimental biogas prototypes have been installed since at least 1978[85], mainly promoted by three organisations:

- Comité Interafricain d'Études Hydrauliques (CIEH) in collaboration with the Institute for Agricultural Research in the Tropics (l'Institut de Recherche Agronomique Tropicale - IRAT);
- Association Internationale du Développement Rural (AIDR) from Belgium ;
- Institut de Recherche en Sciences Appliquées et Technologies (IRSAT), former Institut Burkinabé de l'Energie (IBE).

In 1976, CIEH and IRAT started a research and experimentation program on the valorisation of organic waste by producing compost and biogas[86]. This program completed three phases, financed by the Commissariat de l'Energie Solaire (COMES), aiming at defining the technology, designing and developing prototypes of digester to prepare a dissemination programme. Three villages were selected - Nandjala, Bilbalgo and Mogtedo – and by 1982, several experimental biogas units were installed in CIEH and in the Centre of Saria (about 80 km from Ouagadougou).

From 1978 on, AIDR designed und installed biogas plants in Kongoussi and Goundi, with financial support of the Fonds Economique pour Développement (FED). In 1979, a first household biogas unit was designed und installed for experimentation by CIEH in Boulbi - Centre d'Entraînement à la Culture Attelée – where animal traction has been promoted.

Many other programmes [87] and projects have been initiated by a variety of international organisations between 1980 and 1990. Within the framework of the GTZ Sonderenergieprogramm.[88], IRSAT (former IBE) installed biogas units in several locations: Farakobâ, Koudougou, Gaoua, Fada, Pô, Ziniaré, Pabré, Matourkou, Boromo, Tenkodogo, Yako, Kamboinsé, Kombissiri, Bogandé, Diébougou, Banfora, Polgo et Ouagadougou, Saaba, Zorgho. In the summary of the project report on SEP[89], it was already stated that Burkina Faso is a biogas appropriate country because its potential seems to match well with the SEP requirements. But these conclusions remained without follow up.

In the mid-80ies, the Government launched the *"Programme Populaire de Développement (1984-1987)*", involving directly each Burkinabé in the development of the country. One of the objectives of this program was to supply all 46 provincial health centres with a biogas plant, to use the gas mainly for the sterilisation of medical instruments. During this period, several biogas installations were realised. Four health centres with such installations (Centre hospitalier de Yako, Centre

[85] Nitiema Issiaka : Analyse économique des projets d'investissement dans le secteur des énergies renouvelables (énergie solaire-biomasse) et problématique de la substitution énergétique au Burkina Faso. Mémoire de DEA, 1987

[86] "*Valorisation des déchets végétaux par production de compost enrichi et de biogaz"*.

[87] ENDA TM (2005) The role of renewable energy in the development of productive activities in rural West Africa: the case of Senegal

[88] GTZ: Sonderenergieprogramm. Entwicklung einer Biogasanlage für landlichen Raum Obervoltas in 1881, and „Biogasverbreitungsprogramm Obervolta in 1983"

[89] Prüfbericht über das Sonderenergieprogram (SEP). Entwicklung einer Biogasanlage für landlichen Raum Obervoltas in 1881

hospitalier de Mogtédo, Centre de santé maternelle de Zorhgo, Centre hospitalier de Bogande) have been visited by the Study Team during the Feasibility Mission.

Additionally, community-oriented biogas plants were installed in military barracks or schools from 1980 to 2000. One of them, still functioning, is located at the Collège Technique of Koudougou. This installation, built in 1998 with the support of German founding partners, is connected to the school toilets. The biogas produced is used to partly cover the energy needs for cooking at the school canteen.

As a result of these activities there are some operators throughout Burkina with a great deal of long term experience with their own biogas plant but with no scientific background. Scientific data is however available thanks to the activities of the Interafrican Centre for Hydraulic Studies (CIEH) and the Institute for Tropical Agronomic Research (IRAT), both based in Ouagadougou. These institutes have collected and documented masses of measured data on scientific, institutional and farm pilot biogas plants but have not transferred their technology to sustainable practical applications on family farm level.

2.2 Existing biogas technologies in Burkina Faso

Biogas technology was introduced in Burkina Faso by the Centre Interafricain des Etudes Hydrauliques (CIEH) and the Institut de Recherche Agronomique et Tropicale (IRAT) in 1977, within the framework of a program of studies and experimentation entitled “Valorization of the vegetation wastes by production of enriched compost and biogas” financed by the French Commissariat à l’Energie solaire (COMES). The objectives of this program were:

- To design an experimental digester;
- To define a technology of production;
- To produce prototypes for the domestic mechanical energy and energy production;
- To evaluate the use potential of the products of fermentation (gas and digested sludge);
- To ensure a pre-vulgarisation.

The work undertaken by the CIEH and the IRAT consisted in adapting biogas technology to the conditions of the sudano-sahelian countryside characterized by:

- availability of primarily straw substrates,
- weak integration of agriculture and livestock,
- low availability of water.

For experimental purposes, several dry fermentation batch digester prototypes (based on the Algerian type “Ducellier-Isman”) were developed and installed in CIEH and in the agronomic research centre of Saria by 1982. The experimental digesters consisted of “wells” with walls of some 10 cm thickness of compacted reinforced concrete. At the upper part, two concentric circles spare a water seal in which a metallic lid is inserted. The lid, made of 3 mm thick metal sheets has a cylindrical form. It serves as gas storage, and could contain the gas production of 2 days, i.e. 2 m^3 of gas from a digester of 4 m^3.

These experimental digesters with a discontinuous charge system were gradually replaced by prototypes characterized by the separation of the gas storage from the digester.

From 1978 on, the International Association of the Rural Development (AIDR) constructed digesters in Goundi, with a financial support of the European Development Funds (EDF). These digesters were equipped with a metal lid having a tube of 50 cm height and a diameter of 20 to 30 cm, allowing charging the digester during its operation with liquid livestock wastes (semi-continuous feed system). The intervention of the AIDR on biogas technology in Burkina Faso ended by 1983; its work in close collaboration with the CIEH made it possible to produce digesters at a construction cost of 60,000 FCFA/m^3.

Based on the results of earlier research work, the "Institut Burkinabe de l'Energie" (IBE, actually called Institut de Recherche en Sciences Appliquées et Technologies [IRSAT]) carried out a research program – established with support of the German Appropriate Technology Exchange Centre (GATE, part of GTZ) - from 1982 on with the following objectives:

- Reduction of digester cost
- Development of burners for cooking and absorption refrigerator
- Biogas adaptation of engines originally run by gasoline, gas oil, and oil
- Technological and biological improvements of the outputs of biogas digesters
- Setting up a strategy for pre-vulgarisation of the biogas technology
- Analysing urban biogas application for pork breeders in Ouagadougou

The main results of this program, financed by the Government, and through the Special Energy Program of the GTZ, were:

- Improvement of technology
  - Water seal
  - Lids and fasteners
  - The guidance of the gas meters.
  - Construction materials: ferro-concrete and moulded ferro-concrete were used in the place of the reinforced concrete and the cement blocks.

Through these improvements, the digester cost was reduced from 60,000 to 30,000 FCFA/m^3.

- Adaptation of the appliances of gas
  - Kitchen burner: Burners N° 2, 3, 15, 20, 30 were developed and installed on sites.
  - Refrigerator burner: An absorption refrigerator of 300 litres was adapted to biogas.
  - Motorization: A motor-driven pump, a welding set, and a generator were adapted to biogas.

Only a few of the biogas units installed throughout the country are still working. The problems encountered with these installations were:

- Technical:
  - Leakage of gas on the level of the water seal
  - Cracking of the digester
  - Short life time of installations
- Organisational:
  - Selection of the sites: site with no structure capable to manage the installation due to the social character of the establishment (hospital); unavailability of organic matter on the sites - Medical centres, military camp. Operators had to transport organic matter over long distances.
  - No permanent water supply: lack of water during dry season; to feed the biogas installation, the users had sometimes to go far for fetching water.
  - Lack of ownership because the installations were almost entirely financed by international organizations such as COMES and GTZ. Biogas was economically not competitive as fire wood was not yet bought but still collected for free.

- Missing follow-up to the users, who did not carry out regular und correct maintenance of the installations due to lack of training and ownership.
- Lack of human resources, material and financial means led to a situation where the IBE was not able to make the required follow-up of the installations.

- Social
  - Hard work required for of loading and emptying which was also considered as dirty work
  - Biogas flame was perceived as small and cooking with biogas very slowly.
  - Persistence of traditions and competition with other use of organic matter (fuel wood, animal feed, preparation of potash)
  - No integration of agriculture and livestock activities
  - Inadequate dimensioning of installations: the majority of the biogas units were dimensioned without taking into account the energy needs of the users.
  - Biogas digesters have not yet been recognized as environmental protection technology.

2.3 Lessons Learned

In 1982, a standardized batch type system with a fermenter of 18m³ could be built for US$ 389/m³[90]. In 1983, a BORDA fix dome biogas plant of 10.3 m³ was built for US$ 110/m³; a Chinese-type fix dome plant of 6.95 m³ cost US$ 90/m³[91]. Since then construction prices have increased, while other boundary conditions in favour for biogas have changed.

The main factors that influence the selection of a particular design of a biogas plant have been identified as follows:

1. **Economic.** An ideal plant should cost as little as possible in terms of the production cost per unit volume of biogas both to the user as well as to society. Therefore – independent of the process design - 100% subsidies have been paid – but due to these subsidies, the cost of a plant to the society was higher than to the institution which received the plant. Whilst experience to date has revealed both successes and dissemination-related difficulties in technical, economic and organisational terms, the lessons learned from the economic point of view could guide the design of new local biogas development policies, especially at that time when the country is following a pattern of institutional decentralization.
2. **Design**. The design should be simple not only regarding construction but also for operation and maintenance. This is an important consideration especially in a country like Burkina Faso where the rate of literacy is low and the availability of a skilled work force is scarce. Prefabricated metal gas holders and gas tight covers have been selected as standards, thus generating high transport and material costs. Batch-fed biogas plants operate well regardless of the substrate being fed. Even twigs and unshredded leaves can decompose in these plants. But the system requires manual labour to fill and empty it, a heavy work that calls for strong men; it will generate biogas only irregularly, because the whole batch of filling material is going through the biogas process at once, and gas production needs to start again with a new filling. To partially overcome these disadvantages, batch-fed systems could

[90] Lidon B. and Sola. G., APPLICATION DU BIOGAZ A LA PETITE IRRIGATION, CIEH, Ouagadougou, 1982

[91] Oelert G., Auer F., Pertz K., A Guide to Project Planning Economic Issues of Renewable Energy Systems, 2nd Edition, GTZ, 1988

be composed of several digesters connected with one gas holder, which again increases cost and labour.

While it is recognized, that batch-fed digesters are the simplest biogas generators, it is not advisable that especially in schools students had to operate the batch wise filling and emptying as punishment, as it has been practised in most educational institutions.

3. **Utilization of local materials**. Use of easily available local materials should be emphasized in the construction of a biogas plant. This is an important consideration, particularly in the context of Burkina Faso where transportation infrastructure has not been developed adequately. Due to the subsidy policy this obstacle to a dissemination strategy has never been considered. Today 'real locally' available building materials are mainly red soil, sand, natural stones, cement and cement bricks, PVC- and galvanized piping, offered by commercial hardware services in any commune all over the country. Metal workshops are still centred around the main market places and in urbanized areas.
4. **Durability**. Construction of a biogas plant requires a certain degree of specialized skills, which may not be easily available, and supervision during construction to guarantee water and gas tightness. A plant of short life could also be cost effective but such a plant may not be reconstructed once its useful life ends. Especially in situations where people are yet to be motivated for the adoption of this technology and the necessary skills and materials are not readily available, it is recommended to construct plants that are more durable although this may require a higher initial supervision labour and capital investment.
5. **Suitable for the type of input material**. The design should be compatible with the type of input material that will be used. Fresh manure, fibre-free vegetable pulp, sewage can be put into a continuously charged biogas digester. However, in the 70^{th} and 80^{th} zero- or semi-zero-grazing practices have yet been not common and organic waste, sanitation and sewage has not been considered in any national biogas strategy. Therefore only plant (waste) material such as sorghum or millet straw, maize straw or similar agricultural plant wastes mixed together with dried manure have been promoted. This material led to the point that the batch feeding design or discontinuous system was standardized instead of a design for continuous or semi-continuous feeding.
6. **Frequency of using input and output material**. Selection of a particular design and size of its various components also depend on how frequently the user can feed the system and utilize the gas and the slurry. As R+D project, the standardized batch dry fermentation design filling and emptying frequency was even successfully adapted to irrigation systems to drive motor pumps with biogas.[92]

[92] Lidon, B. and Sola, G., APPLICATION DU BIOGAZ A LA PETITE IRRIGATION, CIEH, January 1982

Box 1: Lessons learned - summarized

30 years experiences from experimentation, research, demonstration biogas projects

Experiences with multiple technologies (floating drum, plug flow, fixed dome, batch-, semi-batch)

«discontinuous» dry fermentation model (batch) was adopted and standardised, but:

- *Requires a lot of hard work and follow-up (no comfort for operation)*
- *High construction material costs (metal cover and gas holder)*
- *Low technical construction quality (cracks and water leakages)*
- *Lack of local capacities for maintenance*
- *100% subsidies (ODA, government, NGOs)*
- *Wastewater not taken into consideration*
- *Women use biogas, but maintenance depends on strong men*

Low quality and efficiency of biogas stoves

Despite difficulties, many biogas installations (estimated 42 out of 60) have been operated for several years (up to 12 years), because of:

- *Lack of alternative for rural energy*
- *Modernity (gas stoves, electricity production)*
- *Use of pre-composted straw stalks for biogas production*
- *Simple and didactic process design*

No real household experience gained; mainly biogas for schools, hospitals, military compounds

3 Feasibility assessment

3.1 Technical feasibility

Given the history of biogas technology implementation and the lessons learned in Burkina Faso, criteria for the selection of an appropriate technical design for “the” initial continues feed fixed dome biogas plant in Burkina Faso are determined by the following 18 parameters:

1. Design and construction method is adaptable to local or regional available construction material.
2. Main criteria for site selection are the convenience of operation and the integration of overflow utilization in the existing or in future improved integrated livestock farming system.
3. Gas tight (pressure tested) construction of gas storage and adequate volume of digester guarantees that the biogas supply from a family size biogas plant is able to meet about 90% of the energy requirement for cooking (on annual basis) for a typical household with few amount on animal dung, at least dung from 2 Tropical Livestock Units (TLU = 250 kg of animal weight).
4. Make possible with adequate gravity filling device and stable connection that feeding of the biogas plant is convenient and all available dung and urine enter the digester resulting in higher gas production and high nitrogen content of overflow.
5. The design allows encouraging the use of more organic matter than animal manure alone.
6. Provide sufficient access to maintain manhole, overflow point and displacement tank in general.
7. Minimize technical maintenance requirement.
8. Daily feed and operation of biogas plant is acceptable for both genders.
9. Available grey-, yellow- and waste water, urine and overflow can be used to dilute dung; no extra water additive should be required in normal operation.
10. Low flush, pour flush or no flush toilet connection (black- or brown water) is technically possible at all time.
11. Shortcut of inflow to outflow is avoided to guarantee a minimum retention time in the digester for energy and hygiene performance.
12. Easy understandable but qualified construction allows rural skill development and encourages the establishment of new craftsmen jobs in rural areas.
13. Overall investment costs are accessible to the target group, supported by financial instruments.
14. The selected average slurry volume permits flexible retention times from 2-3 TLU to 8-10 TLU and connection of toilet facilities (universal basic plant type).
15. Effluent utilization is addressed within the handover training, considering a wider range of options, aiming optimized nutrient recovery and convenience in operation; storage overflow could be combined in gravity flow with compost pit system and/or ferti-irrigation channels and/or drying beds.

16. Permits 21 years of operation time with an average of 1.5% yearly maintenance cost based on the initial investment cost.
17. Technical design allows enough pressure for biogas lightening.
18. Gas piping systems are pressure tested and done with household and environment related security standards.

Checking available and well documented fix dome digester designs from China, Nepal, India, Tanzania, Lesotho, Ethiopia, Bangladesh, Burundi, Burkina Faso, Colombia, Jamaica, Bolivia and Morocco with the above listed criteria, it seems that all the fix dome designs developed at least in Africa are following more or less the same design principles - the main differences are in the manhole position, inlet and outlet structure, well documented in the GTZ-BioSystem-Bio_Calc computer program for the calculation of simple agricultural biogas plants. Going into more detailed screening, it turns out that the adapted TED-Lesotho design and/or the Moroccan bio-digester design seems to be the most appropriate for West African conditions. Further design details should be elaborated during the Implementation Study[93].

All following design and cost calculation are therefore related to the TED Lesotho design[94].

3.1.1 Average daily energy demand

The average daily gas demand depends on household size and need for cooking and lighting energy.

Following the Rapid Household Survey carried out during the Feasibility Study Mission, the energy need of biogas suitable households for cooking and lighting could be roughly estimated:

Table 16: Average energy consumption and costs per year per household (hh)

Cooking (Sample size: 69)				Lighting (Sample size: 69)			
Firewood *69 hh*	Cost FCFA *14 hh*	Charcoal *19 hh*	Cost FCFA *19 hh*	Kerosene *43 hh*	Cost FCFA *43 hh*	Batteries *50 hh*	Cost FCFA *50 hh*
10.45 donkey carts = 5.4 t/y	27514.50 = 42 €/y	19.05 sacs with 40 kg each = 762 kg/y	14528.37 = 22 €/y	32.43 l	15466.16 = 23 €/y	75.10	8240.84 = 13 €/y

The average number of warm meals per day within the households, which are suitable for a biogas plant, counts statistically for 1.9; time spend for cooking each time is given as 2.5 hours, thus 4.75h/d[95]. Average household size in the sample is 13.12 persons varying between 2 and 54 persons who are served.

Resulting from the data given above, maximum average daily cooking fuel demand in fire wood and charcoal of one household is 14 kg and 2.6 kg respectively.

For further calculation, 2 typical average household examples have been chosen, considering that in both cases a standardized 6 m3 slurry volume digester could

[93] See Annex 5
[94] See Annex 5 & 6ff
[95] These data has been given by men: as cooking is women's job, only 57 men in this group gave information on this topic.

cover their daily energy demand for cooking with fuel wood and charcoal, and lighting with kerosene.

Table 17: Average need on household energy/year and energy prices for a rural household with 10 persons

Fuel wood amount	**5,400**	kg/year
Fuel wood costs	**6**	FCFA/kg
Charcoal amount	**240**	kg/year
Charcoal costs	**43**	FCFA/kg
Kerosene amount	**18**	ltr./year
Kerosene costs	**630**	FCFA/ltr.

Table 18: Energy services compared between currently used household fuel and biogas for a 10 person household

Type of source	Input	Conversion efficiencies	Output	Unit
Energy service from fuel wood used for cooking (4.5 kWh/kg)	24,300.00	6.0 %	1,458.00	kWh/y
Energy service from charcoal used for cooking (7 kWh/kg)	1,680.00	22.0 %	369.60	kWh/y
Total cooking			1,827.60	
Biogas for cooking (6 kWh/m3)	3,384.44	54.0 %	1,827.60	
Kerosene lighting service energy (10 kWh/l)	180.00	1.7 %	4.08	kWh/y
Biogas for lighting (6 kWh/m3)	180.00	1.7 %	4.08	kWh/y

Table 19: Average amount on household energy/year and energy prices for a rural family with 20persons

Fuel wood amount	**10,800**	kg/year
Fuel wood costs	**6**	FCFA/kg
Charcoal amount	**480**	kg/year
Charcoal costs	**43**	FCFA/kg
Kerosene amount	**36**	ltr./year
Kerosene costs	**630**	FCFA/ltr.

Table 20: Energy services compared between currently used household fuel and biogas for a 20 person household

Type of source	Input	Conversion efficiencies	Output	Unit
Energy service from fuel wood used for cooking (4.5 kWh/kg)	48,600.00	6.0 %	2916.00	kWh/y
Energy service from charcoal used for cooking (7 kWh/kg)	3,360.00	22.0 %	739.20	kWh/y
Total cooking			3655.20	
Biogas for cooking (6 kWh/m3)	6,768.68	54.0 %	3655.20	
Kerosene lighting service energy (10 kWh/l)	360.00	1.7 %	6.12	kWh/y
Biogas for lighting (6 kWh/m3)	360.00	1.7 %	6.12	kWh/y

3.1.2 Raw material

Available raw material for biogas production on farm household level includes

- Agricultural waste
  Leaves, grass and (pre-composted) shredded straw could be used as biogas raw material, but could even be used for the post-composting of digester effluent in the often already existing compost pits. Pre-composted or pre-silage ligneous fibres and stalks could produce huge amounts of biogas if shredded and mixed in a biogas plant. Silage or chopped compost can be fermented in a biogas plant and used for supplementary biogas production. Chopped silage of approximately 10 % weight could be added to the daily quantity of slurry up to a dry matter content of 8-10% (for such low cost design the maximum is 1m³ manure/ 100kg silage). By adding silage, the daily gas production could be increased by 60%. For the co-digestion of the silage, approx. 30 minutes of additional work is necessary per day to assure substrate preparation. For practical operation, the time involved can be reduced through an improvement of all organizational and technical processes.

- Animal waste
  The average cattle in permanent or semi-permanent stabling results in a higher live weight and therefore a higher manure production, and as in all intensive livestock programs water is already delivered to the animals in the barn to adopt the animal to a permanent stabling.

Table 21: Energy output from different livestock & classification for biogas production

Source	TLU Tropical livestock unit (=250 kg animal live weight)	Annual biogas potential m3/TLU if zero-grazing
Donkey	0.4	292
Cattle	0.9	237
Camel	1	292
Goat	0.12	328
Sheep	0.12	328
Horse	1	292
Pork	0.33	273
Poultry	0.01	365

- Food leftover and kitchen waste
  This consists mainly of organic matter and is relatively digestible. The solid contents of this organic waste are between 20% and 30%. In considering the biogas substrate the basic diet is of great importance, especially when pig breeding is lowered due to Moslem influence. No general statement can be made on this, but a specific assessment in the targeted areas will provide the required data, as the Rapid Household Survey conducted during the Feasibility Study already shows. The quantity of waste produced per person fluctuates a great deal from one situation to the next. Therefore an average amount produced daily by non-pig breeding households must be determined for Burkina Faso. Reports from Egypt states that 85 l of biogas/person/day are produced out of 0.85 kg/person/day of food leftover and kitchen waste,

which means that the demand for cooking energy could be completely covered.[96]

- Toilet effluent
  A septic tank is beyond the means of the average rural household due to the high cost and the unavailability of the mechanical devices for periodic cleaning. Openly disposed human wastes are hazardous to public health and the environment; recycling of human excreta for biogas generation is therefore an important option in order to avoid these health hazards. Calculation based on the common diet in Burkina Faso results in 0.2 - 0.3 m³ of biogas/person which add to the daily gas production.

3.1.3 Technical description of appropriate biogas plant

A biogas digester is a physical structure, commonly known as a biogas plant. As various chemical and microbiological reactions take place in the digester, it is also known as bio-reactor, biogas generator or anaerobic reactor. The main function of this structure is to provide anaerobic conditions within it. As a chamber, it should therefore be air and water tight. It can be made of various construction materials and in different shape and size. Building this structure forms a major part of the investment cost. Since 1962, when the Khadi and Village Industries Commission (KVIC) of India approved Mr. Patel's simple floating drum design, it became popular in India and the developing world. In this design, the digester chamber is made of brick masonry in cement mortar. A steel drum is placed on top of the digester to collect the biogas produced from the digester. Thus, there are two separate structures for gas production and collection.

Floating drum design elements were basically used to develop the Burkina Faso batch design. As this design has proven too expensive and too demanding in operation and maintenance, a plant like this is obviously not appropriate to the country's conditions.

With the world wide introduction of the improved fixed dome Chinese model at the end of the '80's, the floating drum plants became obsolete because of comparatively high investment and maintenance costs along with other design weaknesses. Fixed dome Chinese model biogas plants were built in China as early as 1936 and in the currently known round shape since the 1970's. It consists of an underground brick masonry compartment (fermentation chamber) with a brick dome, concrete or prefabricated plastic dome on the top for gas storage. In this design, the fermentation chamber and gas holder are combined as one unit. This design eliminates the use of expensive steel gas holder which is susceptible to corrosion and depends on metal workshop and transport facilities. Under Burkina Faso's arid climate conditions lifetime of a fixed dome type plant is estimated to range from 20 to 50 years, compared to floating drum plants lifetime of an estimated maximum of 20 years.

Based on the principles of the fixed dome model from China, GTZ/GATE and BORDA developed the first standardized design and demonstrated this in Burkina Faso in 1982/83. This system worked for about 12 years in a secondary school in Pabré near Ouagadougou and has been abandoned only for institutional management reasons. Particular elements of this design that do not conform to other fixed dome plants disseminated in Asia (China, Nepal, and India) are:

- Site planning started from the fertilizer point of demand (convenience of fertilizer utilization);
- Planning and installation with the use of a reference line;

96 Biogas Community Plants Manual – Borda - GTZ 1985

- Installation of a testing unit as part of the standard digester design to allow convenient technical monitoring of digester and piping system;
- All piping system in ¾" and 1" galvanized steel pipe to assure security and long lifetime;
- Operation security was rated higher than lowest investment cost.

The design has not yet been promoted in Burkina Faso due to social and technical reasons:

- The construction requires good skills and supervision for reliable operation.
- The daily labour input for its operation was in most cases too demanding, particularly when it involved animal dung collection, transport and mixing with additionally transported water.

Considering the comparatively high daily gas demand, the proposed technical design is taken from the Lesotho "TED" and the Moroccan design and approach. It is a fixed dome digester functioning according to the so-called Chinese principle, with an expansion channel. The channel is a speciality which at one hand complies with the relatively large gas storage requirement for the Burkina Faso conditions and on the other hand with the objective to ensure a good use of the fertilizer by guiding it via a channel to a compost pit in the vicinity.

Particular elements of the system are:

- The Unit Approach,
- The minimization of water and maximization of urine and grey water as mixing agent
- Site planning starting from the fertilizer demand (convenience of fertilizer utilization)
- Offering toilet connection
- Planning and installation with the use of a reference line
- Addressing possible cracks in the gas tight part of the digester by incorporating the weak ring, without using steel reinforcement.
- No manhole (only for TED design)
- Installation of a testing unit as part of the standard digester design to allow convenient technical monitoring of digester and piping system.
- All piping system in ¾" galvanized steel pipe to assure long lifetime.
- Operation security is rated higher than low investment cost
- Follow-up system by training masons from villages where the biogas plants were constructed.

a) The Unit Approach

A biogas plant works best when it is integrated into a farming system. As farming systems differ, it has to be decided to what extent the technology is standardized and which elements have to be adapted to the individual farming system. The "biogas unit" includes the total package offered to the farmer in connection with the biogas extension work. The main components are: The biogas plant, the stable, the toilet, the compost pit, the slurry distribution canals, the gas piping system, the appliances and the tools to handle the substrate.

On the inlet side the aim is to get the animal manure in the digester as conveniently as possible. This is best provided by a solid stable floor sloping towards the biogas plant inlet. In this case urine enters a urine/grey water collection chamber by gravity. The dung can be pushed into this inlet chamber using a broom. The urine can then serve to wash the dung down in the digester. The contamination of the dung with large amounts of fodder residues or bedding material can be avoided using appropriate feeding practices and sleeping boxes. All these paddock components could be incorporated into existing stable design currently being promoted by various livestock projects. However it is not a *must* to have the stable modified to sophisticated designs, but if convenience in digester feeding is a priority such solutions may be required, and of course will come at a price.

A biogas unit with a good stable design should never require fresh water to feed the digester. The urine and the collected household waste water should be sufficient to dilute the dung.

Also in 'craals' where cattle are kept over night improved floors could be installed. Instead of a concrete floor, concrete tiles (15*15*4.5 cm) could be used to pave the kraal.

Other parts of the unit are support, advice or measures to enhance the utilization of the effluent as fertilizer. Also here the approach should be guided by a key element: *convenience*. As the effluent is in liquid form, its transportation is cumbersome. As farming systems generally require organic fertilizer to be available in bulk at one time of the year, storage pits or compost heaps will be needed for the overflow. Therefore, wherever possible, the liquid overflow should be guided by gravity to the sealed composting pit where it is mixed with lignin rich unshredded plant waste. Such channels should be sidelined by fodder grass which picks up the nutrients leaching into the soil in those channels. Thus the otherwise lost nutrients can immediately encourage the internal nutrient cycle of the farming system.

Other options are to use the overflow in its liquid form as much as possible near the house. This will lead to good crops in the vegetable gardens or in the fields neighbouring the biogas plant.

b) The minimization of water and maximization of urine as a mixing agent

In all cases the effort required to supply the biogas plant with water should be minimized or avoided where possible.

A direct collection from the stable floor makes the minimization of water utilization possible. On the overflow side the moisture component should be recovered in form of providing the moisture to plant roots. The same chamber can be used to collect the grey water from kitchen, showering and washing.

An additional option for the unit approach was developed by the Nepal Biogas Sector Partnership (BSP)[97]: rainwater harvesting tanks with a capacity of 2 to 6m³ are implemented at farmer household level. A similar system exists already in Burkina Faso in Fada N'Gourma and could be extended to biogas users.

c) Offering a toilet connection[98]

Given the sanitation coverage in Burkina Faso, offering a toilet in connection wit a biogas plant could be of great importance for market penetration. A comfortable toilet is the central part of a sanitary biogas unit. Biogas septic tanks are designed as an integrated fixed dome biogas plant. Sanitary aspects, for example a clean toilet with low maintenance costs, could be more important than high gas production.

97 RAIN newsletter June 2006, Rainwater Harvesting Implementation Network (RAIN), Amsterdam, The Netherlands, www.rainfoundation.org

98 Ludwig Sasse, Christopher Kellner, Ainea Kimaro, Improved Biogas Unit for Developing Countries, GATE inGTZ, 1991

Toilets connected to a simple fixed dome biogas plant should be dry toilets or pour flush systems where a minimum of water is used. Water flushing toilets using a large volume of flush water are not suitable for connecting to biogas plants of less than 30 m^3 volume because of the danger of diluting the slurry and thus reducing the retention time.

Hygienic farm environments have to fulfil the following requirements:

- no handling of human excreta; even an accidental touch should be avoided
- no access of flies to undigested excreta
- no worms to escape from a latrine pit
- no bad odour
- no indecent appearance.

Design criteria concerning hygiene and construction quality must be observed (sufficient retention time depending of the slurry temperature, no shortcut flow from inlet to outlet). Main planning criteria are the expected sanitary conditions which depend on frequency of use, frequency of cleaning, and safe slurry disposal. If toilets are connected and no post-composting is intended, slurry should be used for fertilizing trees or shrubs only. The slurry may also drain into a drying bed.

d) Planning and installation with the use of a reference line

As the design aims at gravity inflow and gravity outflow, the correctness of levels in the construction is of utmost importance. This is reflected in the technical drawing and the trained method of construction. The digging levels are not left to the digger's perception but are clearly defined in relation to where the overflow of the biogas plant should be. This point, once defined, will give the reference to all other levels which have to be considered during construction.

e) Addressing possible cracks in the gas tight part of the digester

The special design feature has to be understood as an element which was developed as a result of observations of cracking in 21 Tanzanian biogas digesters of the first 40 biogas plants built in the hemispherical shape with a wall thickness of 11 cm (2 cm outside plaster, 7cm thickness of brick wall and 2 cm inner plaster). The cracking happened mainly in the rainy season, as the soil had softened This led to a loss in strength in the backfill which no longer provided the support needed to the digester wall in the lower section of the hemispherical structure.

The solution was found by incorporating a predefined circular crack called the weak ring, followed by a thickened line of bricks, called the strong ring. This structure proved to lead to a reliably crack free and gas tight upper part of the dome and was introduced as a standard element of the CAMARTEC design. Today, CAMARTEC just builds the strong ring, while further design developments (Lupo Design Ethiopia and TED Design Lesotho) integrate none of these rings but reinforce the structure with wire mesh inserted in the outside plaster. This allows constructing hemispherical digesters with a brick thickness of 7 cm up to a radius of 2.4 m, leading to a digester volume of up to 28 m^3. Larger digesters up to 100 m^3 should have a brick wall thickness of at least 12 cm.

f) No manhole

The most obvious weak point of the CAMARTEC and the Moroccan digester is the centralized manhole. The wooden wedges deteriorate after some years and the high gas pressure can establish capillary leaks in the clay. To organize good quality clay in Burkina Faso, where even burnt clay bricks are no longer available, may prove to be a difficult task. The logical consequence of this would be to avoid the use of the centralized manhole when possible. This proposition is justifiable as continuous fed digesters in Burkina Faso have never needed to be opened and emptied even during a period of operation of up to 12 years.

g) Operation security is rated higher than low investment cost

This includes a follow-up and certification system by training masons and craftsmen from villages where biogas plants are to be constructed.

3.1.4 Required components and materials

If the construction materials to be used in the plant construction such as cement, sand, and aggregate are not of good quality, the quality of the plant will be poor even if the design and workmanship are excellent. In order to select material of best quality, a brief description regarding the specifications is given below.[99]

a) Cement

The cement to be used for construction should be of high quality Portland cement from a brand with a good reputation, available in Burkina Faso.

b) Sand

Sand for construction purpose should be clean. Dirty sand has a very negative effect on the strength of the structure. Course and granular sand can be used for concreting work but fine sand will be better for plastering work.

c) Gravel

Gravel should not be bigger than 25% of the thickness of the concrete product where it is used in. As the slabs and the top of the dome are not more than 10 cm thick, gravel should not be larger than 2 cm in size.

d) Water

Water is mainly required for preparing the mortar for masonry work, concreting work and plastering. It is advised not to use water from ponds and irrigation canals for this work, as it is usually too dirty. Organically loaded wastewater has an adverse effect on the strength of the structure; hence water to be used must clean.

e) Bricks

Cement bricks must be of the best quality locally available. They must be well dried and regular in shape. Before use, bricks must be soaked for few minutes in clean water. Such bricks will not soak moisture from the mortar afterwards.

99 Sundar Bajgain, Nepal Biogas Plant -- Construction Manual, Construction Manual for GGC 2047 Model Biogas Plant, Biogas Support Programme (BSP), P.O. Box No.: 1966, Kathmandu, Nepal, September, 1994

f) Stones

If stones are to be used for masonry work, they have to be clean, strong and of good quality. Stones should be washed if they are dirty.

g) Water (gas) proof agent

A water proof agent is added to the cement for gas tightness. A water proof agent based on plastic is preferred over crystalline components because of greater elasticity. To obtain gas tightness, twice the manufacturer's recommendation for water tightness is added to the cement. The use of water proof agent solves the problem of gas tightness of the plaster. Any kind of surface paint is difficult to apply because the structure is still "sweating" for a long time and the surface will not be as dry as recommended for painting. Other methods, like paraffin coating require higher skill and close supervision. Thin bituminous paints are washed away in little time by the movement of slurry. Further, materials composed of carbohydrate are principally affected by methane bacteria.

h) Biogas Piping System

Pipes should be short and straight, preferably not more than 30 cm below the ground. Biogas contains water vapour. If the gas cools below the dew point of the water vapour then condensation forms. Water always collects at the lowest point in the pipe. Therefore, pipes are laid in slope of min. 1%. At the lowest level is either the biogas plant itself or an automatic water drainage device, called water-trap. If pipes are not laid in slope and do not have a water-trap at the lowest point, the gas supply system will collapse after only a few weeks. Therefore, the bottom of the pipe trenches must as well be even, otherwise water might collect at hollows blocking the gas-flow.

Gas pipes should not pass roads or trenches with potential danger of soil erosion. All gas pipes are of 3/4" or 1” diameter and preferably of galvanised iron (G.I.) or HDPE-PN6 or PN10 pressure pipes[100]. Joints must be sealed by grease and hemp (not sisal!) or by Teflon tape. Bends and junctions should be kept to a minimum because they reduce gas pressure and are potential points of leakage. Unions are especially harmful and should be avoided unless absolutely necessary. Their outer threads must be sealed with hemp or Teflon, their inner threats with silicon latex.

For long distances without junctions or joints, PVC-PN6 or PN10 pressure pipes which are suitable for underground installation may be used. They are cheaper, but pipes of smaller diameters might be attacked by rodents. Care must be taken by joining plastic pipes with G.I. pipes. Avoid unforced flexible hose pipes, use fibre reinforced material.

3.1.5 Quality parameters and methods to test the quality

a) Construction Site Selection

The following points should be kept in mind when deciding on a site for biogas plant construction.

- For proper functioning of the plant, the right temperature has to be maintained in the digester and the inlet point: a sunny site is recommended.

[100] *Conforming to DIN 8074, 8075, SFS 2336, 2337, ISO 161*

- To make plant operation easy and to avoid wastage of raw material especially dung, the plant must be as close as possible to the stable and urine / waste water storage or source.
- If longer gas-pipes are used, cost will increase as pipes are expensive. Furthermore, longer pipes increase the risk of gas leakage due to more joints required. Therefore, the plant should be as close as possible to the point of gas use in order to limit leakage and pressure lost problems.
- The foundation of the plant should be at least two meters away from the house or any other building to avoid risk of damages.
- Even as the construction is intended to be water tight, the plant should be at least 10 metres away from the well or any surface water sources to avoid water pollution.

b) Biogas Piping

Installation of a testing unit as part of the standard digester design allows convenient technical monitoring of the digester and piping system. It was found helpful and necessary to install a combination of T-joint, main valve and T-joint directly adjoined to the gas outlet pipe of the digester, to allow technical monitoring of the installation while in use. Pressure tests of the digester and the piping system can be easily organized and a gas meter can be installed without interfering in the piping system in the kitchen. This standard of the design provides convenient access to the gas pipe system for learning and understanding.

Before fitting the pipe, dust must be blown out of each piece of pipe or fitting. Pressure tests are to be undertaken for every 30 m of piping installed. If the gas pressure of 1.40 m water column cannot be maintained for 10 minutes, all joints must be checked for leakages by applying soap water. Pressure tests can only be carried out under steady temperature conditions. Direct sunlight and alternating cloudy periods have great influence on the temperature and gas pressure inside the exposed pipes. The final pressure test is done with all the accessories connected.

3.1.6 Household appliances

Biogas appliances are pieces of equipment for utilizing the energy of the gas. Either special biogas appliances are used or pressure-kerosene or LPG equipment is adapted.

Biogas is mainly used in stoves for cooking and in gas lamps for lighting. But also refrigerators and incubators, coffee roasters, driers, baking ovens and water heaters, chicken or piglet heaters, power engines for milling or generating electricity could be fuelled with biogas.

The gas equipment market in Burkina Faso offers stoves, lamps and refrigerators run by LPG or kerosene, which could be adapted to the characteristics of biogas for further marketing in a biogas dissemination programme.

3.1.7 Operation and maintenance requirements

a) Start-up Operation

When construction is completed, the digester can be loaded with digestible material. For best performance the plant should initially be filled with cattle manure and water. If there is not enough manure conveniently available, the remaining volume can be filled with water. The correct filling is to the bottom of the expansion channel, with the gas valve being open; then the valve should be closed. The manure will settle to the bottom of the digester and after some days it will start producing gas and pressure will be established.

It is not likely that the first gas produced will burn, as air gets trapped in the gastight part of the digester and the newly established biology mainly produces carbon dioxide ($C0_2$). After some days the methane (CH_4) concentration in the gas will naturally increase and when it reaches around 50%, the gas will start to burn.

After another few days the gas will reach its final quality of approximately 65% CH_4, 34% $C0_2$ and less than 1% H_2S (but average gas quality depends of the digestion material). During this time small amounts of the daily filling material can be added. The start of the routine feeding depends on the feeding material. Manure and faeces can be added from the start of operation in full quantity. In case agricultural and garden waste, grass, straw, or acid citrus waste is the digestion material the bacteria in the digester must first adapt to the feeding material. Therefore it is best to start with 1 bucket per day and increase to two to three buckets after a week.

During the start up phase it is necessary to observe the gas quality. If the burning quality can be seen to diminish (more $C0_2$ in the gas), feeding should be stopped for some days. In a later stage, whenever the feeding material is unbalanced and new fodder is provided for the bacteria, it is necessary to give the new digestion material in small doses first and increase it gradually (e.g. rotten fruits, fat, grease, spoiled agro-industrial waste…)[101].

b) Fertilizer use

Slurry discharged from the digester may be rather liquid or pulpy. This depends on the consistency of the input material. In any case the material still contains all the nutrients, which have entered the digester. In this respect a bio-digester is much more efficient as a “fertilizer factory” than any other method of handling organic waste. All material discharged can be used to fertilize annual or perennial crops as well as trees and seedlings. The main problem to overcome is that the distribution of the liquid material is rather labour intensive, therefore the combination with a compost pit is recommended.

In order to achieve an efficient use of the material, gravity flows should be utilized wherever possible. In case there is a slope downwards from the digester the overflow can be guided in dug out channels to the area of utilization or to the compost pit. Along such channels fodder grass can be established to utilize the infiltrating water and nutrients.

Effluent from digesters with toilets connected often has the stigma of being a possible source of diseases through pathogen germs. University research results of projects in Burundi (1987-1990) and Tanzania (1989 – 1991) however have proven that no pathogen germs could be identified from the liquid overflow from digesters with retention times over 20 days and short cut preventions by higher viscosity or inside separation walls. In case sewage waste water is treated and the retention time in the digester is below 20 days, the overflowing water should receive a mandatory post treatment in the compost pit or flow through a gravel bed and or root treatment system, which provides another retention time. The aerobic conditions there will remove smelling components and lead to a cleaner irrigation water as well. The plants in the root treatment system will also remove a part of the nutrients from the water.

[101] Christopher Kellner, Manual for the Construction of a Bio Digester, TED Design, Edition for Lesotho, Maseru, August 2005

It is important to consider the use of the fertilizer in the siting and planning process of the digester.

c) Regular Maintenance of Appliances

The stove fuelled by the biogas should be regarded as a kitchen appliance and not as a fire place. There is no maintenance needed besides keeping it clean like other kitchen vessels and utensils.

Biogas fuelled lamps need cleaning of the glass screen in order to ensure a bright light at all times. Cleaning should be done only if necessary to avoid shocks on the lamp that may destroy the gas mantle. Gas mantles of lamps only have a certain life time and ought to be replaced frequently. They are fixed with a string to the nozzle and the replacement is easy and does not require any skill.

Mantle material (thorium)[102] from all kerosene, benzene or gas pressure lamps are radioactive. Therefore, dust or pieces of the broken mantle should not come in contact with foodstuff. Children should be protected from inhaling the dust when they are around. Hands and working place should be cleaned with water after replacement of the mantle.

d) Maintenance of Toilets

Well designed toilets should not require any major maintenance except for cleaning the inlet and the floor of the cubical. Once a toilet is soiled and starts smelling badly it is very difficult to achieve cleanliness again. Clean water should be used without disinfectants so as not to kill the methane bacteria in the plant. Soapy water and dissolved cloth washing powder can be tolerated.

3.1.8 Technical, construction and operation risks

a) Scum and sediments

The proposed TED Lesotho digester design does consider the formation of scum or the necessity to check it or remove it. The high and huge designed outlet as well as the up and down movements in the digester regularly encourages small sections of the swimming layer to float out of the digester and accumulate in the expansion channel. The frequency depends on the amount of organic matter, which does not decompose easily – like wooden particles and straw.

In case frequent blockage problems occur, after several years of operation, the swimming layer has to be removed by opening the outlet cover. A complete emptying

[102] Since thorium is radioactive and produces a radioactive gas, radon-220, as one of its decay products, there are concerns about the safety of thorium mantles. A study in 1981 estimated that the dose from using a thorium mantle every weekend for a year would be 0.3-0.6 millirems, tiny in comparison to the normal annual dose of a few hundred millirems, although a person ingesting an entire mantle would receive a comparable dose of 200 mrem. However the radioactivity is a major concern for those people involved with the manufacture of mantles and with contamination of soil around some former factory sites. All of these issues have meant that alternatives, usually yttrium or sometimes zirconium, are used in some countries although they are either more expensive or less efficient. One potential cause for concern is that particles from Thorium gas mantles "fall out" over time and get into the air where they may be ingested in food or drink. These particles can also be inhaled and remain in the lungs or liver. Secondary decay products of Thorium include Radium, Actinium, and Radon gas. http://en.wikipedia.org/wiki/Gas_mantle

of the digester would only be necessary if several m³ soil, sand or stones have entered it and reduce the digester volume considerably.

If there is heavy biogas release from the inlet but not enough gas available for use, scum is most likely the reason. Often the gas pressure does not build up because of the continuous release through the inlet. Slurry does not overflow for weeks. There is the danger of blocking the gas pipe by rising scum because of daily feeding without equivalent discharge. Straw, grass, stalks and even already dried dung tends to float to the surface. Solid and mineral material tends to sink to the bottom and, in the course of time, may block the outlet pipe or reduce the active digester volume. In proper mixed substrate there is no such separation because of sufficient friction within the paste-like substance.

With pure and fresh cattle dung there is no scum problem. Floating layers will become a problem when husks are part of the fodder. This is often the case in pig breeding. Before installing a biogas plant at a piggery, the kind of fodder and consequently the kind of dung, must be checked to ensure it is suitable for a direct biogas plant inflow. It might be necessary to grind the fodder into fine powder. The user must be aware of this and the related costs before deciding on a biogas unit.

The problem is even bigger with poultry droppings. The kind of fodder, the sand the chicken pick up, and the feathers falling to the ground make poultry dung a difficult but very energy and fertilizer value rich useful biodigester substrate.

b) Interruption of Gas Production

By far the most common problem mentioned by the user is the presumed lack of gas.

If the problem occurred suddenly, a technical fault is very likely. If gas supply dropped gradually, one may guess that there is something wrong with the performance of the plant. This might be caused either by unsuitable properties of the feeding material or by inadequate feeding practices.

If the gas pressure is high but no gas reaches the point of use, there must be a blockage somewhere. If there was no discharge of slurry because of not enough pressure inside the plant, there might be a leakage in the plant.

If there is smell of gas in the kitchen, all valves and joints have to be checked for leakages. If no leakage is found, but gas is produced, which can be seen if bubbles come up at the outlet or inlet pipe, while pressure does not build up, there must be either a leakage which opens up by increased pressure or a crack in the dome below a certain slurry level. A crack in the dome is the worst of all cases. The plant must than be emptied and cracks must be repaired.

If there is no gas production in the plant, and the slurry smells sour, the fermentation process has been disturbed. Such a break down of fermentation is very rare and rarely happens with animal dung, except in case of animal diseases treated with high doses of antibiotics.

If gas is not available at only some of the appliances, there is a blockage in the piping system or the jet. If jets are clean, there might be a water blockage in the piping system just before the appliances.

If the gas flame was flickering before it finally went off, change the pipe line or place a water trap. If there is once water in the pipe, there will be always water in the pipe. Reconstruction of piping segments is the only solution.

c) Disturbance of the System

Trouble shooting becomes necessary if the customer complains about insufficient service or any nuisance caused by the plant. There are three sources for possible complains:

- insufficient gas plant performance
- inadequate amount or kind of feeding material
- too high expectations on the service of a biogas unit

Serious information about possibilities and limitations of a biogas plant are the only way to have content customers. On the other hand, the farmer might have exaggerated the amount of feed material available to him. The actual amount of dung must be checked in order to maintain the functioning of the plant to produce 35 - 45 litres of biogas per kg of fresh cattle dung, depending on fodder, temperature and retention time. In rainy seasons the gas production may drop to 60-70% of the normal rate in Burkina Faso.

3.2 Financial and economic feasibility

It must be stated that in the past the methods of calculation dealt with are limited to those costs and benefits which are directly attributable to the Biogas Programme. They didn't encompass any possible external benefits such as:

- Improvements in the physical quality of life as a result of a wider range of energy supply
- Improvement of soil fertility and food security
- Improvements in the local economic structure
- Reduction in environmental pollution esp. ground water pollution and GHG-emissions
- Creation of employment opportunities
- Improvement in the trade balance through the substitution of imported energy sources
- Long-term training effects
- Reduction of rural migration
- Reduction in deforestation
- Reduction in desertification

or external costs such as:

- loss of income for firewood and charcoal merchants
- shortage of capital and increase in interest rates because funds which could be used as future operating costs in systems utilizing conventional energies become immediately payable as investment costs for the utilization of renewable energies.

Since the success of the Nepalese Biogas Programme, economic and financial cost-benefit analyses carried out by WINROCK international[103] refer to the individual household level for financial analysis and to the society level for economic analysis.

[103] Winrock international: Biogas for Better Life – an African initiative – A cost-benefit analysis of national and regional integrated biogas and sanitation programs in sub-saharan Africa – prepared for the Dutch ministry of foreign affairs, draft & discussion paper presented in Nairobi, Kenya May 2007

Following the Nepalese example, a cost-benefit-analysis has been carried out within Burkina Faso framework conditions.

Table 22: Costs and benefits of an integrated energy and sanitation invention

Level of analysis	Costs	Benefits
Household-level analysis	Cost of biogas plant at the subsidized rate Cost of a pour-flush toilet Repair and maintenance cost of plant and toilet Cost of extra-time consumed due to biogas installation and adoption of improved hygiene practices Cost of hygiene materials purchased by the household Financing costs, if applicable	Savings in expenditures for cooking and lighting fuel Time saving due to biogas installation: firewood collection, cooking time, personal hygiene needs Savings in households health-related expenditures Income effects of improved health, improved lighting, and improved financial situation Saving in fertilizer, if applicable
Level of analysis	**Costs**	**Benefits**
Societal-level analysis	Full cost of biogas plant and toilet Repair and maintenance cost of plant and toilet Cost of extra-time consumed due to biogas installation and adoption of improved hygiene practices Cost of hygiene materials purchased by the household Technical assistance Program costs related to biogas and hygiene, including financing	Cooking and lighting fuel savings Chemical fertilizer saving Time saving due to biogas installation: firewood collection, cooking time, personal hygiene needs Savings in all health-related expenditures Tax income effects of business creation and employment within biogas programme, Income effects at community level due to biogas and toilets Impact of increased purchase power on local economy Long term effects from training and knowledge transfer GHG reduction Reduction of deforestation and desertification Reduction of ground water pollution

3.2.1 Capital requirements & cash flow

The economic feasibility of biogas generation varies a great deal depending upon the factors such as the availability of domestic energy sources, the cost of imported fuel, the uses and actual benefits of biogas production, location and local factors such as climates and cropping systems. All these factors have to be taken into account in any benefit analysis.

a) Total Capital Cost

The following calculation is based on data collected in April 2007 in Ouagadougou, Fada N'Gourma, Bogande, Gaoua and Bobo-Dioulasso. Comparing the price differences, the most expensive market price has been chosen for TED design digester in Burkina Faso. From these data (**see Annex 6a**) the total construction cost for a 6 m³ (slurry volume) biogas fixed dome digester in Burkina Faso is determined.

Table 23: Percentage of cost fraction in biogas system construction

Item	%	Total FCFA
cost of materials	46.24 %	208100.00 FCFA
cost of in/outlet pipes	8.17 %	36755.00 FCFA
cost of personnel	19.11 %	86000.00 FCFA
cost of gas pipes	6.29 %	28300.00 FCFA
cost of gas appliances	12.44 %	56000.00 FCFA
cost of transport	4.17 %	18750.00 FCFA
miscellaneous costs	3.58 %	16095.00 FCFA
TOTAL	**100.00 %**	**450000.00 FCFA**

The inclusive cost of a 6m³ TED design biogas plant with all fittings and basic appliances is assumed to be EUR 686.00[104] in Burkina Faso, corresponding to US$ 912.00, both at exchange rates in June 2007.

Program subsidies from national or international funds and in-kind contributions by the household estimated at 10%[105] of the total construction cost could reduce the required capital investment cost:

Table 24: Household level financial costs (FCFA / US$) for a 6m³ biogas plant

Proposed subsidy	Total cost of the biogas plant	Subsidy	in-kind contribution (10%)	net financial capital cost
0.00	450,000 FCFA 912 US$	0.00 0.00	45,000 FCFA 91 US$	405,000 FCFA 821 US$
30%	450,000 FCFA 912 US$	135,000 FCFA 274 US$	45,000 FCFA 91 US$	270,000 FCFA 547 US$
35%	450,000 FCFA 912 US$	157,500 FCFA 319 US$	45,000 FCFA 91 US$	247,500 FCFA 502 US$
300 US$	450,000 FCFA 912 US$	147,600 FCFA 300 US$	45,000 FCFA 91 US$	257,400 FCFA 522 USD

Resulting from the Rapid Household Survey, the maximum amount the better-off households interested in biogas pronounced to be able and willing to contribute as capital investment was about 200,000 FCFA. Therefore it is obvious that for market penetration a micro-financing system has to be established accompanying a future National Domestic Biogas Programme.

Figures from other African countries with Biogas Programmes like Ethiopia and Uganda show that the construction cost of a 6m³ biogas digester in Burkina Faso is comparatively high. They correspond to construction costs in Rwanda where a 6 m³ Nepal GGC 2047 design is calculated at 859 US$. Subsidy per household biogas plant in Rwanda is considered at US$ 300.

Applying this subsidy policy of about 35% of total construction cost to Burkina Faso frame conditions, the net financial capital cost per 6m³ household plants could be reduced to US$ 502 (FCFA 247,500 or EUR 377).

Applying a subsidy of US$ 300 to 6m³ biogas plants in Burkina Faso lowers the net financial capital cost per household to US$ 522.

104 based on exchange rate 2007-06-15 (EUR 1.00 = 656 FCFA = 1.33 US$) and prices in April 2007

105 Winrock international: A Cost-Benefit Analysis of National and regional Integrated Biogas and Sanitation Programs in sub-Saharan Africa, 2007

b) Annual operation & maintenance cost

As biogas is a proven technology, the lifespan of a fixed dome biogas plant can be expected to be at least 20 years. Besides the biogas plant construction cost as capital investment in the first year, annual cost includes operation, maintenance and repair expenditures.

Following experiences in Asian countries, annual repair and maintenance cost is estimated at 1.5% of the total construction cost[106]. Annual financial cost for operating the plant – dung and water collection and mixing - are basically calculated at zero; although in locations, where households have to pay for water or water transport these expenditures have to be taken into account. During the Household Survey 33 out of 69 biogas suitable households confirmed that they have to pay for water and/or water transport, an average of 15261.54 FCFA/household/year (= EUR 23.00 or US$ 31). But for Burkina Faso's integrated rural biogas plants no extra mixing water transport is foreseen, as described before.

3.2.2 The Clean Development Mechanism (CDM)

Burkina Faso ratified the Kyoto Protocol on March 31st, 2005 and had entered it into force on June 29th, 2005 by establishing the Designated National Authority (DNA): since this moment Burkina Faso is as such eligible as host country for CDM projects.

The DNA must issue the statement that the project participants participate voluntarily and must confirm that the project activity assists the host country in achieving sustainable development.

Box 2: Contact details of the DNA Burkina Faso

Le Secrétariat Permanent du Conseil National pour l'Environnement et le Développement Durable (SP/CONEDD)
Avenue Bassawarga, porte No. 392, côté ouest de l'ex "Camp Fonctionnaire",
près de la Station Total de la Cathédrale de Ouagadougou
6486 Ouagadougou 01, Burkina Faso
(spconedd@yahoo.fr, spconedd@fasonet.bf)
Phone: (226-50) 312 464, (226-50) 313 166 / Fax: (226-50) 31 64 91

b) Annual operation & maintenance cost

The development of the CDM project documentation and the involvement of different institutions throughout the project cycle generate substantial costs; estimates are given in the following table.

Table 25: Estimated costs related to an approval of a CDM project

Cost Component	To be paid to	Estimate
Project preparation cost	Consultant for PDD writing, communication with government, etc.	30 – 40 man days, plus travel costs
Validation	DOE	10,000 – 14,000 €
Registration	EB • USD 0.10/CER for the first	

[106] Winrock international, 2007

Cost Component	To be paid to	Estimate
	15.000 tCO_2 • USD 0.20/CER for any amount exceeding 15,000 tCO_2 (max. USD 350.000) • no fee for projects below 15,000 tCO_2 annually	
Monitoring	-	10,000 €
Verification and certification	DOE	10,000 – 14,000
Issuance of CERs	EB 2% of the CERs issued must be paid as adaptation fee. Least developed countries are exempted	
Legal works	Consultant To work out agreements of CER distribution among project participants	5,000 – 10,000
Transfer costs	Broker To market CERs	to be negotiated

b) CDM methodologies

Although a detailed implementation plan of the biogas programme in Burkina Faso is not yet available, it is anticipated that in the frame of this programme different CDM project measures would be feasible. As the small-scale project methodology, Type I – Renewable Energy Projects, I.C., Thermal energy for the user, is no longer considering firewood replacement, under which three projects (two in Nepal, one in India) have been registered, other alternative strategies should be developed, based on all possible methodologies.

- AMS-I.C. Thermal energy for the user with or without electricity

This category comprises renewable energy technologies that supply individual households or users with thermal energy that displaces fossil fuels. Examples include solar thermal water heaters and dryers, solar cookers, energy derived from renewable biomass for water heating, space heating, or drying, and other technologies that provide thermal energy that displaces fossil fuel. Biomass-based co-generating systems that produce heat and electricity are included in this category.

- AMS-III.D Methane recovery in agricultural and agro industrial activities

This project category comprises methane recovery and destruction from manure and wastes from agricultural or agro-industrial activities that would be decaying anaerobically in the absence of the project activity by

(i) Installing methane recovery and combustion system to an existing source of methane emissions, or

(ii) Changing the management practice of a biogenic waste or raw material in order to achieve the controlled anaerobic digestion equipped with methane recovery and combustion system.

- AMS-III.H.: Methane recovery in wastewater treatment

This project category comprises measures that recover methane from biogenic organic matter in wastewaters by means of one of the following options:

(i) Substitution of aerobic wastewater or sludge treatment systems with anaerobic systems with methane recovery and combustion.

(ii) Introduction of anaerobic sludge treatment system with methane recovery and combustion to an existing wastewater treatment plant without sludge treatment.

(iii) Introduction of methane recovery and combustion to an existing sludge treatment system.

(iv) Introduction of methane recovery and combustion to an existing anaerobic wastewater treatment system such as anaerobic reactor, lagoon, septic tank or an on site industrial plant.

(v) Introduction of anaerobic wastewater treatment with methane recovery and combustion, with or without anaerobic sludge treatment, to an untreated wastewater stream.

(vi) Introduction of a sequential stage of wastewater treatment with methane recovery and combustion, with or without sludge treatment, to an existing wastewater treatment system without methane recovery (e.g. introduction of treatment in an anaerobic reactor with methane recovery as a sequential treatment step for the wastewater that is presently being treated in an anaerobic lagoon without methane recovery).

If the recovered methane is used for heat and or electricity generation that component of the project activity can use a corresponding category under type I.

- AM0013: Avoided methane emissions from organic waste-water treatment --- Version 4

This methodology refers to the installation of an anaerobic digester with biogas extraction capacity at an existing organic wastewater treatment plant to treat the majority of the degradable organic content in the wastewater. In this case, there is a process change from open lagoon to accelerated CH4 generation in a closed tank digester or similar technology. Therefore, depending only on the amount of captured methane emissions to establish baseline emissions will not be adequate as the project activity may extract more CH4 than would be emitted in the baseline case. The extracted biogas may be flared or used to generate electricity and/or heat. The project activity therefore reduces the amount of CH4 allowed to dissipate into the atmosphere. By also utilizing the biogas, instead of flaring the CH4, the project will also contribute to the displacement of grid electricity or fossil fuel consumption, further reducing GHG emissions. The residual from the anaerobic digester after treatment is either dewatered and applied to land or directed to anaerobic lagoons.

Post-treatment of the sludge happens in aerobic conditions through dewatering (drying) and land application.

- ACM0010 Consolidated methodology for GHG emission reductions from manure management systems --- Version 2

This methodology is applicable generally to manure management on livestock farms where the existing anaerobic manure treatment system, within the project boundary, is replaced by one or a combination of more than one animal waste management systems (AWMSs) that result in less GHG emissions. It is applicable to manure management projects under the following conditions:

• Farms where livestock population comprising of cattle, buffalo, swine, sheep, goats, and/or poultry is managed under confined conditions;

• Farms where manure is not discharged into natural water resources (e.g. rivers or estuaries);

The AWMS/process in the project case should ensure that no leakage of manure waste into ground water takes place, e.g., the lagoon should have a non-permeable layer at the lagoon bottom.

c) Revenues related to an approved CDM biogas project

Recently, the UNFCCC authorities decided that a local/regional/national policy or standard cannot be considered as a Clean Development Mechanism project activity, but that project activities under a programme of activities can be registered as a single clean development mechanism project activity provided that approved baseline and monitoring methodologies are used that, inter alia, define the appropriate boundary, avoid double counting and account for leakage, ensuring that the emission reductions are real, measurable and verifiable, and additional to any that would occur in the absence of the project activity. This “Guidance on the registration of project activities under a programme of activities as a single CDM project activity (Version 01)” document provides the basic guiding principles for the registration of project activities under a programme of activities as a single CDM project activity, and may be revised as the body of knowledge expands on project activities under a programme of activities. This should be taken in consideration for the proposed Burkina Faso biogas programme.

Besides the Kyoto market, other actions taken to reduce greenhouse gas emissions are being verified and traded. Voluntary markets for emissions reductions that are exempt from the provisions of the Kyoto Protocol are developing rapidly. Companies are increasingly concerned about their environmental impact and tend to neutralise activities they cannot avoid, e.g. travelling by airplane. They understand voluntary offsetting as part of their corporate responsibility and/or as part of their image strategy. Emission offsets in this category are usually verified by independent agents and are commonly referred to as Verified Emission Reductions (VERs). VERs are not a standardized commodity like the CERs; there is a lack of quantitative data publicly available for the voluntary carbon market.

Transaction costs are particularly problematic when the volume of CERs being offered is relatively low. As a thump rule it can be said that a project activity should generate at least 10,000 CERs to safely cover the costs for CDM preparation. If the emission reduction of a project activity is below that threshold projects can be implemented as VER projects. Although VER projects have not to go through the project cycle, they should be developed and documented according to CDM rules and procedures, e.g. to use the PDD format to develop the project. In order to become reliable it is recommended to validate the project.

The current market price for CERs is 5-6 EUR for medium-risk forwards, 7-8 EUR for low-risk forwards, 8-11 EUR for registered projects and 10-12 EUR for issued CERs. The price for VERs is considerable lower and is 3 – 6 EUR. Demand for both types of credits exists.

Experiences from different Biogas Program have shown that an average emission reduction of about 1.79 to 4.99 tCO_2 per annum can be reached[107].

Using this value, it can be estimated to achieve yearly earnings from CDM between 6 and 60 EUR per plant/year in the first seven years, depending of the type of gained certificate.

[107] Jason Yapp: Agricultural Engineering in Support of the Kyoto Protocol, *The Clean Development Mechanism for Biogas* Technology, APCAEM, Beijing, 2006

Box 3: CER examples from biogas programmes

Project	India[11]	China[12]	Nepal[13]
Livestock per Household (HH)	4 cows	3 pigs	4 cows
Digester number	5,500	10,000	200,000
Digester size	2 m^3	8 m^3	4-10 m^3
kW/digester	1.81kW	1kW	1.16 to 2.32 kW
Certified Emission Reduction (CER)/digester/yr	4.93	1.79	4.99
CER (tCO_2e /yr)	27,111	17,967	530,000
Cumulative CER	189,905 for 7 years	179,670 for 10 years	5.3 $MtCO_2e$ for 10 years
1. Baseline	- Replace firewood from non-renewable sources - Replace inefficient wood stove - Replace 46 l/yr/HH kerosene with biogas	- Replacement of firewood from non-renewable sources - Replace inefficient wood stove with biogas - Replace smoky coal	- Replace firewood from non-renewable sources - Replace kerosene with biogas
2. Monitoring plan	- Rely on support sale service contractor to monitor on the number of digester installed and in operation	- Local Energy Bureau working alongside Village Biogas Association	- Rely on biogas contractor to monitor installed and operational digester
3. Total Transaction cost (US$) – Taken from Table 2	US$ 80,000	US$ 80,000	23 PDDs (9,000 biogas plants per PDD) x 80,000 per PDD = US$ 1,840,000
i) Upfront (US$)	US$ 50,000	US$ 50,000	23 PDDs (9,000 biogas plants per PDD) x 50,000 per PDD = US$ 1,150,000
ii) Annual Operational (US$)	US$ 30,000	US$ 30,000	23 PDDs (9,000 biogas plants per PDD) x 30,000 per PDD = US$ 690,000
Transaction cost as % of CER revenues at US$4 per tCO2e	9.4%	11.2%	4.6%
Sustainable Development Benefits in meeting the Millennium Development Goals	• **Economic:** Improved income from improved productivity and diversified activities; generate new employment and new skills, improved balance of payment. • **Social:** Improved health through clean biogas for cooking and light, hot water; less time for firewood collection, light for studying at night • **Environmental:** Access to organic fertilizer for healthy food production and rehabilitation of degraded land; less fly vectors, mitigate greenhouse gases (GHG) emissions from methane and nitrous oxide, improve water quality and opportunity to harvest rain water		

11 Taken from CDM PDD submitted for the Bagepalli Biogas project, under validation.
12 Taken from a report sponsored by ADB to study the potential for developing small scale CDM projects in China.
13 Taken from PDD submitted for Nepal Biogas Program by World Bank's Community Development Carbon Fund.

3.2.3 Internal rate of return

Household fuel is in very short supply in rural Burkina Faso. Where conditions still permit, wood is commonly used as fuel, and in some rural and urban areas, charcoal is a major source of fuel for cooking.

During the household survey in two provinces no use of dried dung as fuel has been found. When dung is processed into biogas and the output slurry is recovered for use as fertilizer, both areas household energy and fertilising soil are addressed. Wood burns at open-fire at 5–8% efficiency (UNESCO, 1982).

The energy in dung may be converted to methane at approximately 40% efficiency, which may be utilised in cooking at up to 60% efficiency. When charcoal is burned directly in an improved stove, its energetic efficiency increases to 22%, but there are 7 times more wood used to produce charcoal with the existing rural conversion technology level.

If animal dung and human excrements are both first processed in a biogas digester, more usable energy and plant nutrients can be obtained and with a post-composting a better hygiene could be guaranteed. The nutrient content (mainly N and P) of the remaining slurry is essentially the same as in the unprocessed dung, but the higher Ammonium content is better absorbable by roots.

Technology for Development (TED-Lesotho), CAMARTEC-Tanzania, ORMVA-Sous-Massa (Morocco) and other African biogas institutions have developed – based on Chinese design standards - a simple, round shape biogas digester which processes organic matter, mostly animal dung, into gas usable for cooking, lighting and heating. Prototypes of this digester are currently being used by a few institutions in Burkina Faso, mostly to produce gas for cooking.

Household-size biogas plants in general – and even more after the successful biogas programme implementation in Nepal and the social market oriented dissemination approach from the Chinese Ministry of Agriculture - show a strong micro-economic feasibility which is quite stable with respect to influences of real investment cost, labour cost for construction, and operation or cost for energy supply which had to be paid for. When firewood or biomass waste is the competitor – as it is in Burkina Faso – extended analytical efforts are recommended prior to programme implementation in order to demonstrate to potential users the financial benefit of the investment. The micro-economic assessment may tend to be pointless when an ecologically critical situation has to be tackled – as in the case in Burkina Faso – and the society itself has a political interest in promoting the use of biogas plants.

The following considerations and calculations are based on the Winrock International System of Cost-Benefit Analysis, developed specifically for DGIS and the African Initiative “Biogas for Better Life”[108].

Biogas has not yet a direct commercial value, but its use can generate positive impacts on households and society’s economy. As already described in chapter (3.2.1) costs and benefits are shared on both levels. The following case studies refer to savings in the purchase of cooking and lighting energy. They do not include income generated by applying biogas for productive use, nor the economic impact of fertilizer use and improved sanitation. As it is shown quite clear in Case 3, a Biogas Sanitation system is not feasible if only energy aspects are considered. But as soon as other costs like desludging a septic tank are taking into account, beside external economic benefits for the community, the IRR will improve significantly.

[108] Winrock international, 2007

Box 4 : Case 1: 6m³ Biogas Household System (without revenues from fertilizer) for 10 person household and 2 TLU

Inflation rate (%)	4	https://www.cia.gov/library/publications/the-world-factbook/geos/uv.html			
Real discount rate (%)	6		Firewood amount	**5400**	kg/year
Nominal discount rate (%)	10,24		Firewood costs	**6**	FCFA/kg
Operation&Maintance rate	1,50%		Charcoal amount	**240**	kg/year
CER	8	€/t CO2	Charcoal costs	**43**	FCFA/kg
CER from 2008 to	5	years	Kerosene amount	**18**	ltr./year
Exchange rate FCFA/€	656	FCFA/€	Kerosene costs	**630**	FCFA/ltr.
Lifetime	21	years			
Biogas used per year	**594**	M3	99,34%	biogas used	
Tropical livestock unit	**2**	TLU			
Stable grade (24/24 =1)	1	day	**zero grazing**		
Persons using toilet	**10**				
Biogas potential from toilet	70,000	M3/year			
Total biogas potential per year	**598,000**	M3/year			
saving cooking energy	42.720	FCFA/y			
saving lightening energy	11.340	FCFA/y			

Option	**Without Carbon Revenue**			**With Carbon Revenue**			**Investment cost (FCFA)**	
	NPV (FCFA)	**FIRR (%)**	**PBP (y)**	**NPV (FCFA)**	**FIRR (%)**	**PBP (y)**		
Option 1: only Cooking	-47.689	0,00%	5,0	69.379	13,89%	2,93	398.200	FCFA
Option 2: plus Lighting	326	10,25%	5,47	310.585	21,18%	2,84	450.000	FCFA

Box 5: Case 2 – 6m³ Biogas Household System (without revenues from fertilizer) for 20 person household and 5 TLU

Inflation rate (%)	4	https://www.cia.gov/library/publications/the-world-factbook/geos/uv.html			
Real discount rate (%)	6		Firewood amount	**10.800**	kg/year
Nominal discount rate (%)	10,24		Firewood costs	**6**	FCFA/kg
Operation&Maintance rate	1,50%		Charcoal amount	**480**	kg/year
CER	8	€/t CO2	Charcoal costs	**43**	FCFA/kg
CER from 2008 to	5	years	Kerosene amount	**36**	ltr./year
Exchange rate FCFA/€	656	FCFA/€	Kerosene costs	**630**	FCFA/ltr.
Lifetime	21	years			
Biogas used per year	**1.188,148**	M3	81,38%	biogas used	
Tropical livestock unit	**5**	TLU			
Stable grade (24/24 =1)	1	day	**zero grazing**		
Persons using toilet	**20**				
Biogas potential from toilet	140,000	M3/year			
Total biogas potential per year	**1.460,000**	M3/year			
saving cooking energy	85.440	FCFA/y			
saving lightening energy	22.680	FCFA/y			

Option	**Without Carbon Revenue**			**With Carbon Revenue**			**Investment cost (FCFA)**	
	NPV (FCFA)	**FIRR (%)**	**PBP (y)**	**NPV (FCFA)**	**FIRR (%)**	**PBP (y)**		
Option 1: only Cooking	352.851	25,12%	2,4	586.987	48,44%	1,43	398.200	FCFA
Option 2: plus Lighting	507.189	29,48%	2,74	1.158.902	56,88%	1,39	450.000	FCFA

Box 6: Case 3 - 6m³ Biogas Sanitation Household System (without revenues from fertilizer)

		https://www.cia.gov/library/publications/the-world-factbook/geos/uv.html			
Inflation rate (%)	4				
Real discount rate (%)	6		Firewood amount	**0**	kg/year
Nominal discount rate (%)	10,24		Firewood costs	**6**	FCFA/kg
Operation&Maintance rate	1,50%		Charcoal amount	**218**	kg/year
CER	8	€/t CO2	Charcoal costs	**43**	FCFA/kg
CER from 2008 to	5	years	Kerosene amount	**3**	ltr./year
Exchange rate FCFA/€	656	FCFA/€	Kerosene costs	**630**	FCFA/ltr.
Lifetime	21	years			
Biogas used per year	**103**	M3	98,10%	biogas used	
Tropical livestock unit	**0**	TLU			
Stable grade (24/24 =1)	1	day	**zero grazing**		
Persons using toilet	**15**				
Biogas potential from toilet	105,000	M3/year			
Total biogas potential per year	**105,000**	M3/year			
saving cooking energy	9.374	FCFA/y			
saving lightening energy	1.890	FCFA/y			

Option	**Without Carbon Revenue**			**With Carbon Revenue**			**Investment cost (FCFA)**	
	NPV (FCFA)	**FIRR (%)**	**PBP (y)**	**NPV (FCFA)**	**FIRR (%)**	**PBP (y)**		
Option 1: only Cooking	-360.339	0,00%	31,2	-340.042	0,00%	17,66	398.200	FCFA
Option 2: plus Lighting	-400.927	0,00%	27,86	-362.655	0,00%	17,54	450.000	FCFA

3.2.4 Critical risk factors

The main risk factor in the financial sector is to be seen in the fact that most of the biogas suitable farm households are well acquainted to traditional energy sources – often at low cost - and applications. Investing in a modern integrated system for cooking and lighting requires sharing of information and responsibilities among men and women, as both genders have their well-defined role in collecting, purchasing, using and benefiting from traditional energy sources. As mainly men as household heads decide on investments, but women and children will be the first persons to use biogas as cooking energy, financial and technical responsibilities has to be shared among all members of a household. This may lead to either no investment - if the household head is not convinced about the benefits for him – or to malfunctioning of the plant – if the women are not involved in training, operation and maintenance of the plant. In both cases, economic success of the NDBP would be endangered.

Table 26: Surveyed households: their willingness & ability to contribute to improvements

Sample size ***(%)*** *HH = households*	**100** *(100%)*	**69** *(100%)* *All biogas suitable HH*	**43** *(100%)* *poor biogas suitable HH*	**23** *(100%)* *Medium economy biogas suitable HH*	**3** *(100%)* *better-off biogas suitable HH*
HH with Credits	35 *(35)*	26 *(38)*	15 *(35)*	9 *(40)*	1 *(33)*
HH with Savings	32 *(32)*	22 *(32)*	8 *(19)*	14 *(61)*	0 (0)
Nr. of HH able to co-finance “biogas”	83 *(83)*	58 *(84)*	32 *(75)*	23 *(100)*	2 *(67)*
Average Amount US$	**71.39**	**84.68**	**49.48**	**142.93**	**20.27**
Nr. of HH willing to co-finance “biogas”	91 *(91)*	63 *(92)*	37 *(87)*	23 *(100)*	2 *(67)*
Average Amount US$	**68.92**	**84.62**	**51.97**	**146.42**	**20.27**
Nr of HH able to co-finance general improvements	81 *(81)*	58 *(84)*	34 *(80)*	21 *(92)*	1 *(33)*
Average Amount US$	**62.46**	**72.83**	**65.89**	**92.54**	**40.55**
Nr. of HH willing to co-finance general improvements	81 *(81)*	57 *(83)*	34 *(80)*	22 *(96)*	0 *(0)*
Average Amount US$	**105.82**	**124.51**	**124.27**	**130.54**	**0.00**

From these data it is obvious that among the biogas suitable households the ability and willingness to invest and contribute financially to general improvements and to a biogas plant installation is quite higher than the average. Although it has to be considered that at the moment of conducting the survey no financial information about cost and economic benefits have been given; furthermore, not all households have been willing to give precise data on their financial situation.

In order to avoid financial problems at household level, a strategy of subsidies and micro-financing mechanisms should be developed. This strategy should include also a set of accompanying measures to support farmers (men and women) making productive use of biogas.

Successful dissemination and market penetration would also be at risk, if the programme would aim at cheapness of the plants and not at viability[109].

3.3 Social, environmental and political feasibility

Increasing fossil fuel and fertilizer prices have led to a renewed interest in the use of anaerobic digestion processes through integrated biogas systems for the efficient management and conversion of agro-industrial wastes into a clean renewable energy and organic fertilizer source. The methane captured in the biogas will mainly be used for cooking, lighting and for household based supply.

3.3.1 Policy: The Millennium Development Goals and biogas

Although there is no MDG in energy, biogas technology can positively impact on poverty alleviation and the achievement of the Millennium Development Goals (MDGs) in Burkina Faso, thus improving social and environmental conditions and supporting sustainable development policies.

Box 7: Links between a National Domestic Biogas Programme and the MDG

MGD 1: Eradicate extreme poverty and hunger

- *Enhance integration of agriculture and animal husbandry for improvement of agricultural resources*
- *Create employment in the biogas construction sector*
- *Promote decentralized training and knowledge transfer*
- *Improve access to sanitation and reduce related illnesses*
- *Enhance food security by improving agricultural yields through application of biogas slurry*
- *Improve local economy by offering renewable energy from local organic resources (animal dung, human waste, agricultural and food processing waste)*

MDG 2: Achieve universal primary education

- *Improve students assistance in school by reducing illnesses like diarrhoea and acute respiratory symptoms*
- *Provide good lighting for school children for doing their homework*
- *Reduce the time children have to spend for firewood collection*
- *Improve school sanitation facilities, energy supply for school canteens and organic fertilizer for school gardens*

MDG 3: Promote gender equality and empower women

- *Facilitate time saving energy supply to empower through alternative social and economic activities*

[109] Kellner, C: Biogas Extension in Developing Countries, Presentation at Asia-Pacific Biogas Conference, Singapore 2007

- *Promote female students assistance in past primary education by offering privacy and hygiene with biogas sanitation facilities*
- *Empower housewives by including them from the beginning in the development of the National Domestic Biogas Programme as operators of biogas burners, lamps and refrigerators*
- *Empower women as multiplicators of new technologies at household level*

MDG 4: Reduce child mortality

- *Reduce air pollution from smoke, associated respiratory diseases and accidents from open fire*
- *Improve sanitation and hygiene education*
- *Reduce parasitic infections, diarrhoea and other water and vector borne diseases*

MDG 5: Improve maternal health

- *Create healthy and clean environment at household level*
- *Reduce labour burden on women for energy supply*
- *Reduce health risks from fuel wood transportation like headache and spinal pain*
- *Free time for making use of health services*

MDG 6: Combat HIV/AIDS, malaria and other disease

- *Create healthy and clean environment at household level*
- *Reduce fly and vector breeding ground and related diseases which may affect HIV patients*

MDG 7: Ensure environmental sustainability

- *Protect groundwater from contamination*
- *Reduce deforestation and desertification*
- *Control GHG emission from livestock and organic waste disposal*
- *Recycle nutrients and restore soil fertility*
- *Promote environmental awareness and link it with economic advantages*

MDG 8: Develop a global partnership for development

- *Link the National Domestic Biogas Programme with the African Initiative “Biogas for Better Life”*

3.3.2 Knowledge on and experiences with biogas

Practical implementation, knowledge and experience with biogas is very limited in Burkina Faso as this has to date been mainly a field for researchers and research institutions.

However, while searching and visiting biogas plants which have been constructed in the 1980’s, several persons came up with personnel experiences they have made with the plant at that time:

- Former students who are now teachers, administrators or principals at colleges which have been equipped with a plant relate biogas

- On one hand to a modern technology, which provided electrical lighting (College Boromó) – generated by biogas, and smokeless, odourless fuel for the kitchen of the school (Center of Rural Formation Farakoda) or for the priests (Petit Séminaire Pabré).
- On the other hand, due to the siting or the installed system, charging the biogas digester has been a "punishment" (Pabré) or a hard work (Farakoda) which was not easily accepted.

- Staff of Health Centres and hospitals remember that the biogas plants have been working
  - in the best case for about 3 years, and were only abandoned as a result of political changes in 1987 (Zorgho)
  - in the worst case were never used, due to bad construction work (Bogande).

3.3.3 Acceptance of biogas

As biogas systems are not really known in Burkina Faso, the Study Team prepared a brochure with basic information on the process and the technology. Each interview partner received this basic information with further explanations; he/she has than been asked about

- his/her own experience with biogas
- his/her personal opinion about the technology
- his/her judgements if this technology could be accepted in Burkina Faso considering economic, ecological, social and cultural aspects
- his/her judgements if this technology should be introduced in Burkina Faso

The team was extremely surprised by the overwhelmingly positive response, which were further underlined by the results of the Stakeholder Workshop and the Rapid Household Survey:

- 30 stakeholders out of the 30 participating in the workshop at the end of the mission voted for a NDBP Burkina Faso
- Out of about 70 visited potential stakeholders – Ministries and administration, Associations, NGOs, international agencies and donors, over 60 stakeholders clearly pledged their support to a future biogas programme
- 91 out of the 100 surveyed households clearly stated their interest to learn more about biogas and to improve their energy and environmental living conditions by installing a biogas plant – however, only 69 of these actually have access to the necessary biomass and have already started a integrated farm management process.

Critical voices saw potential obstacles to a successful dissemination mainly in:

- cultural patterns of livelihood systems of the different ethnic groups
- poverty
- lacking access to funds
- lack of technical skills in the rural areas.

3.3.4 Acceptance of the attachment of toilets

In 2005, 60% of the population had access to an improved water source and 29% to basic sanitation facilities[110]. These figures translate into 51% for rural and 85% for urban areas. These average figures should be treated with extreme caution as they hide disparities between and within provinces[111]. For access to sanitation, official statistics suggest a breakdown of 69% for urban areas and 15% for rural areas[112], while the African Ministers Council of Water estimates 14% in urban areas and 10% in rural areas[113].

By the nature of their biological processes, biogas plants present an ecological technology for sanitation and waste water treatment. Biogas technology could offer a system to make significant improvements in the national sanitation sector, given the following facts:

- sanitation coverage in Burkina Faso is extremely low - with a national coverage of about 11%
- few existing wastewater treatment systems present poor performance.

Two mainstreams in policy and rural innovation have been identified as most supporting factors for a NBDP:

1. As part of the National Programme for Water Supply and Sanitation 400.000 toilets are planned in rural areas by 2015 by the Direction d'Assainissement. An estimated 10% of these will be low- or pour-flush toilets. Septic tanks with soak away to receive this wastewater are comparatively expensive and require regular sludge maintenance while no safe method of faecal sludge treatment can be provided.
2. Modernization in rural areas, increased formal education, mobile phones, motor bikes and cars, and television promote the awareness on lacking toilet facilities; this leads to discussions in the villages about the most appropriate sanitation system.

A toilet itself is no longer seen as being outside of the tradition; safety, privacy and hygiene are recognized as basic needs by the villagers themselves, although they often don't know yet how to achieve this.

According to the latest statistics from the Ministry of Agriculture, Water Resources and Fisheries (MAHRH), latrine coverage in rural areas remains at 1%; traditional latrines which do not meet official standards are left out of the equation. Only those sanitation facilities that prevent humans, animals and insects from contact with human excreta are classified as "improved technologies".

Analysis of the Rapid Household Survey reveal that 24 out of 69 (35%) potential biogas households – with at least 2 cows or 4 pigs in semi-permanent stabling - have already installed a pit latrine, and 64 (93%) are willing to invest in sanitation improvements. Given potential cultural constraints, taboos and stigmas against the connection of a toilet to the biogas digester, a future biogas programme will have to consider awareness

[110] GoBF 2006; PEA 2005
[111] WABF 2005a
[112] PEA 2005
[113] African Ministers Council on Water, Getting Africa on track to meet the MDG's on Water and Sanitation, 2006

raising campaigns and information activities to promote the sanitation aspect of biogas technology.

The survey revealed further that among the "biogas suitable" households about 65% are applying animal manure to their plantations and about 7% are even using the slurry from their pit latrine for fertilising. Experiences in other countries show that this topic is important to be discussed before including a toilet connection in the standard package of a national biogas dissemination programme.

Table 27: Future biogas plant connected to toilet - gas use for cooking and lighting?

Could you imagine using biogas produced from human excreta?	**All surveyed households 100**	**69 biogas suitable hh**			
		All 69 "biogas" households	**Poor households: 43 out of 69**	**Medium level households: 23 out of 69**	**Better-Off households 3 out of 69**
Yes	52 (52%)	33 (47.8%)	20 (46.5)	11 (47.8%)	3 (100%)
No	22 (22%)	19 (27.5%)	8 (18.6%)	11 (47.8%)	0
I don't know yet	26 (26%)	17 (24.6%)	15 (34.8)	1 (4.3%)	0
Total	100	69	43	23	3

3.3.5 Relevant governmental regulations

In 1996, when the first sanitation strategy was developed, water supply was still part of the environmental sector. The Environmental Code of 1997 quotes the Ministry of the Environment as the responsible agency for waste disposal and the management of rainwater. A few years later, competences for water supply and sanitation were moved to the agricultural sector. Since then, competences of the current Ministry of Environment and Living Conditions (MECV) with regard to sanitation have been reduced to environmental protection issues such as avoidance of water pollution and the management and control of solid, industrial and medical waste. Within MECV, the General Directorate for the Improvement of Living Conditions (DGACV) is the responsible agency for the sub-sector[114].

3.3.6 Social & environmental risks

Social risks could be related to increased differences in living conditions among those households with and those without biogas installations. A national biogas programme has to implement several strategies which enhance local economic development and create employment also for unskilled labour, thus distributing income to all economic levels in society.

Switching to biogas requires the decision of both, men and women in the concerned household. In the overall society in Burkina Faso, men are in most cases the decision makers on large investments of the household. But biogas energy use for cooking and lighting will firstly affect women: they will have to change their cooking habits and work rhythm. Collecting firewood is – like fetching water - not only a burden, but also a social activity which brings women together. When introducing biogas in a household, this

[114] http://www.odi.org.uk/rpgg/publications/reports/0701_sanitation_burkina.pdf, http://tilz.tearfund.org/Research/Water+and+Sanitation

time-out could be missed by the involved women, if there will be no social substitution for.

Households with toilets connected to a biogas plant could run the risk to suffer from stigmatisation if cooking, lighting and fertilising with this mixed slurry from animal and human excreta is not accepted in the local society. The programme has therefore to analyse in depth potential cultural barriers to the connection of a toilet and include the sanitation package as an offer, not a must.

Based on experiences in other countries (China, Burundi, Lesotho), biogas plants have been proven as safe treatment system of human and animal excreta. As the biogas digester has to be constructed in a water and gas tight manner in order to meet operational requirements, environmental risks for groundwater and air contamination should not exist. In case of inappropriate gas use or filling techniques, they are significantly reduced compared to pit latrines, septic tanks, leaking compost pits or open air disposal of any organic waste.

Environmental risks could be related to methane losses due to insufficient gas use by the household. Since methane is an approximately 20 times stronger greenhouse gas than carbon dioxide, the methane losses should be kept low by enhancing the total biogas use for cooking and lighting. The methane losses are also negative for the plant economy.[115]

3.4 Market viability

Commercial dissemination concepts should be applied to the national biogas programme; therefore analysis of potential market size and customer groups has been undertaken by the Study team.

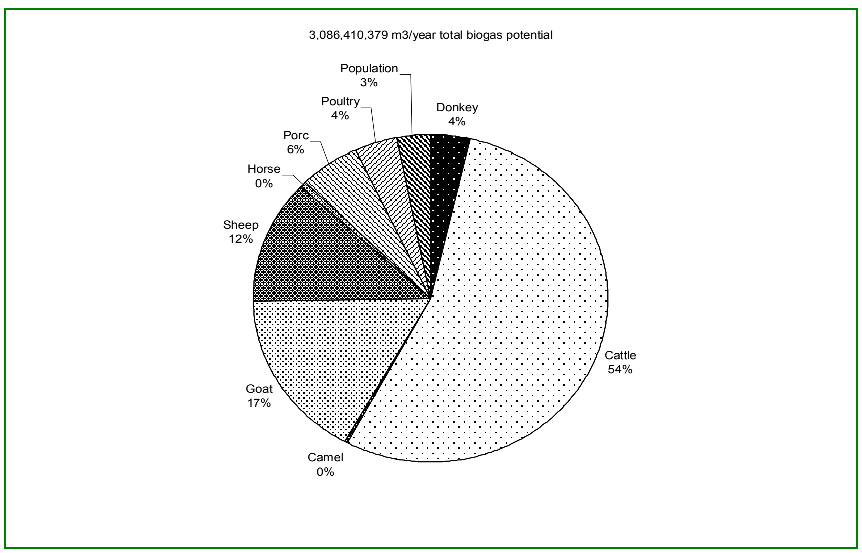


Figure 5: Theoretical biogas potential according to raw material producers (persons and livestock)

115 Persson, M. – School of Environmental Engineering Lund University Sweden, 2003: Evaluation of upgrading techniques for Biogas

Calculations of the biogas market potential are primarily based on livestock statistics, population census and livestock market documentation, revealing as one general result that market viability for biogas technology in Burkina Faso is not to question. With a total population of 13.4 Mio and a total number of 26 Mio animal resources, theoretical biogas potential achieves about 3.1 billion m^3/y.

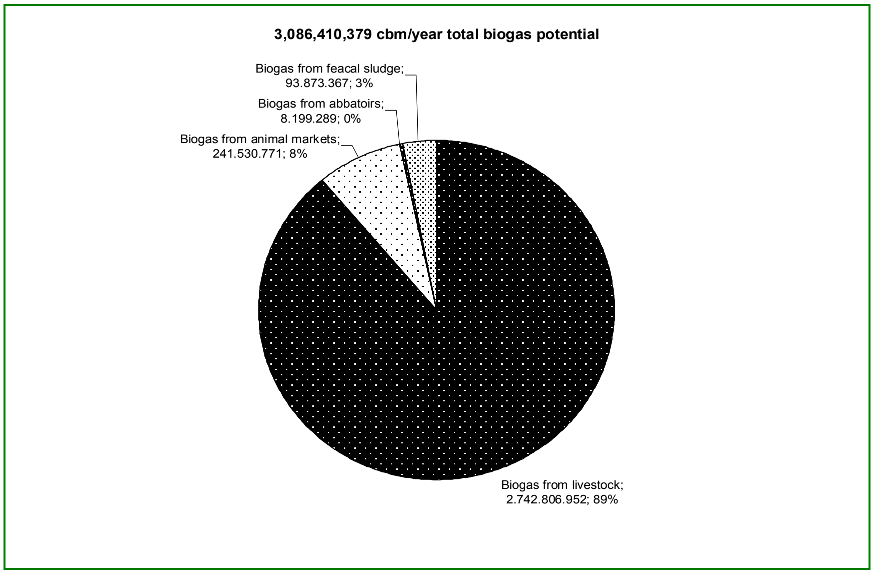


Figure 6: Theoretical biogas potential according to raw material sources (facilities)

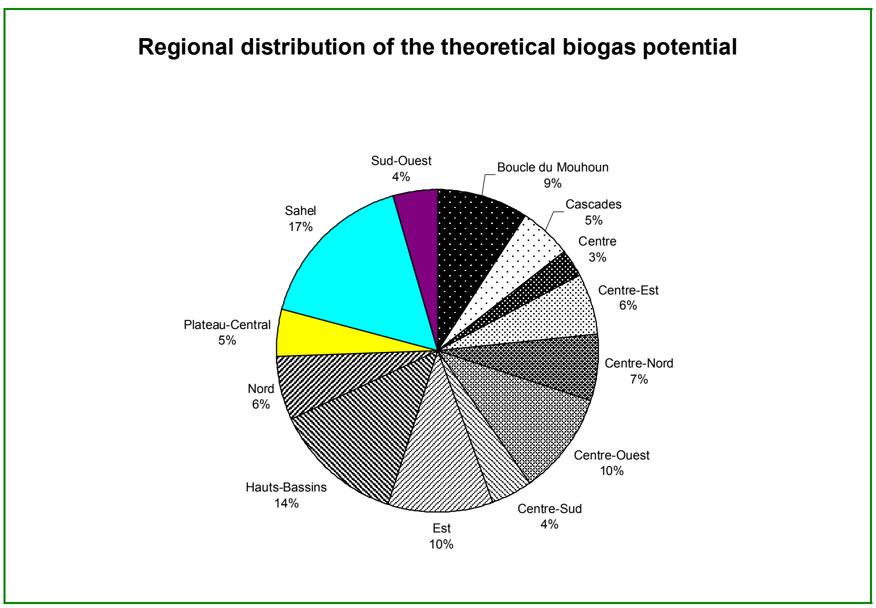
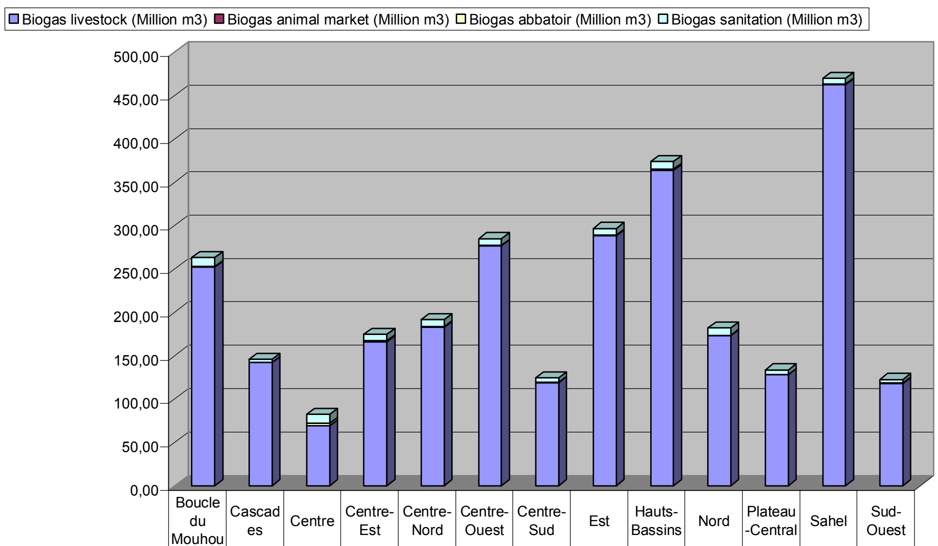


Figure 7: Regional distribution of theoretical biogas potential

Due to different environmental and climatic conditions, water availability, agricultural and livestock husbandry systems, the theoretical biogas potential is unevenly distributed over the country. Coupled with different livelihood systems – resulting in heterogeneous economy patterns, the market viability for a National Domestic Biogas Programme has been further screened applying the criteria

- Livestock husbandry system: zero or semi-zero grazing
- Compost programs
- Livestock trade



	Boucle du Mouhou	Cascades	Centre	Centre-Est	Centre-Nord	Centre-Ouest	Centre-Sud	Est	Hauts-Bassins	Nord	Plateau-Central	Sahel	Sud-Ouest
Biogas sanitation (Million m3)	10,11	3,67	10,67	7,23	7,91	7,68	5,11	7,74	9,44	8,07	5,50	6,38	4,37
Biogas abbatoir (Million m3)	0,78	0,24	2,53	0,85	0,41	0,40	0,28	0,60	0,97	0,31	0,18	0,41	0,25
Biogas animal market (Million m3)	0,00	0,00	0,18	0,33	0,36	0,03	0,00	0,24	0,10	0,13	0,00	0,46	0,03
Biogas livestock (Million m3)	252,14	142,26	69,25	166,25	182,70	277,01	119,07	288,32	363,81	173,30	128,10	462,44	118,15

Figure 9: Theoretical biogas potential in each region, availability of different feed material

The overview on regional distribution of the theoretical biogas potential shows quite significant differences between regions. More detailed analysis provides indicators for specific focus on raw material sources and thereby potential customers of biogas systems.

Although *Figure 9* reveals the most impressive biogas potential deriving from livestock, regional differences are to evaluate in Chapter 3.4.2

Calculation has been further done considering the Tropical Livestock Unit TLU which gives the statistical value for each animal type as 1 TLU = 250 kg live weight[116].

Table 28: Tropical Livestock Unit equivalents in Burkina Faso

Animal	TLU equivalent
1 cattle	0.9
1 donkey	0.4
1 camel	1.0
1 horse	1.0

[116] FAO Livestock environmental toolbox, 1975

Animal	TLU equivalent
1 pig	0.33
1 goat	0.12
1 sheep	0.12
Poultry (1 from any kind)	0.01

In the context of the National Domestic Biogas Programme, non-stabled poultry will not contribute significantly to biogas production. Therefore they are not considered in the calculation of TLU per household.

Table 29: Statistical regional average of Tropical Livestock Units per rural household

Region	Total Population	Rural Population	Households *(10 persons)*	Tropical livestock unit / household
Boucle du Mouhoun	1,444,639	1,155,711	144,464	6.30
Cascades	524,956	419,965	52,496	10.81
Centre*	1,523,980	0	260,955	0.93
Centre-Est	1,032,778	826,222	103,278	5.63
Centre-Nord	1,129,990	903,992	112,999	5.73
Centre-Ouest	1,097,795	878,236	109,780	8.74
Centre-Sud	729,656	583,725	72,966	5.61
Est	1,105,260	884,208	110,526	9.77
Hauts-Bassins	1,348,442	1,078,754	134,844	10.36
Nord	1,152,403	921,922	115,240	5,18
Plateau-Central	785.796	628,637	78,580	5.70
Sahel	910,740	728,592	91,074	19.68
Sud-Ouest	624,046	499,237	62,405	6.85
Burkina Faso	**13,410,481**	**9,509,201**	**1,449,606**	**8**

**Ouagadougou, therefore only urban households with an average of 5.84 persons*

The national average TLU/habitant is 0.8, indicating the baseline for livestock based specific biogas potential.

3.4.1 Target customers

The National Domestic Biogas Programme should be designed with priority to the needs and benefits of rural and peri-urban households. However, given the conditions of Burkina Faso, small and medium sized food processing units as well as livestock related rural and urban facilities have been visited and analysed. Viable customer potential according to the availability of biomass for biogas production has been identified in:

- Small farms and rural households for biogas from livestock, sanitation and agricultural wastes
- Peri-urban households for biogas from sanitation and organic domestic wastes
- Small scale food processing industry for biogas from organic wastes and sanitation
- Livestock markets for biogas from animal wastes and sanitation
- Slaughterhouses and abattoirs for biogas from animal wastes and sanitation

a) Small farms and rural households

There are about 1.45 Mio rural households with a statistical average of 8 TLU.

Among 100 rural households selected by chance for a Rapid Household Survey, 69% have been identified as potential biogas clients according to predefined criteria

- Intensive Livestock for animal traction, dairy production or fattening (meat production)
- Infrastructure: Semi-permanent productive stable system, compost pits, or toilet/latrine
- Water availability: water supply for animals and compost plants, collection and use of domestic waste water or paddock with concrete floor to collect animal urine.

Table 30: Surveyed households: their animals and stabling systems

Sample size	**total HH members**	**HH size (average)**	**Animals** Cattle		Donkeys		Pigs		**Stabling system**	
			Avge	Total	Avge	Total	Avge	total	P	O
100 (all)	1208	12.08	6.69	669	0.56	56	4.13	413	48%	75%
69 *(biogas suitable)* (100%)	905	13.12	8.74	603	0.72	50	5.54	382	63%	100%
43 *(poor)* (62%)	519	12.07	5.09	219	0.23	10	7.4	318	54%	100%
23 *(medium)* *(34%)*	354	15.39	15.91	366	1.52	35	2.17	50	87%	100%
3 (better-off) (4%)	31	10.3	8.3	25	2	6	0	0	33%	100%

Avge = average *Stabling system: p = permanent, o = overnight or semi-permanent*

Deeper analysis focussed on gas demand for cooking and/or lighting, fertilizer use and need, and the ability and willingness to co-finance the improvements expected from installing a biogas plant. Collecting real household economic data proved to be quite problematic at this stage. Only a limited number of heads of households were willing to provide a rough monthly or annual income calculation. Therefore all interview partners have been asked to characterize the own household with one of 3 economic categories “poor – medium – better-off”. Only 3 persons referred to “I don’t know” while their socio-economic data and living conditions put them in the category of better-off households. In all economic groups several household heads confirmed that they would prefer to contribute to the sanitation and energy system improvement in kind or with labour rather than in cash. This information has been considered in the numbers of households which are able and willing to contribute.

Table 31: Current energy costs for households suitable for biogas system

Sample size	Fuel	Households paying for fuel	Average cost per year (FCFA)
69 Biogas suitable households	firewood	43	27514,50
	charcoal	19	14528,37
	LPG	4	14250,50
	Kerosene	42	15834,40
	Electricity	7	23457,71
	Batteries	48	55084,21

The increase in time and effort for collecting firewood is a damaging factor to the health of women in rural areas. Women become more vulnerable to diseases. If the mother is often sick or tired, the welfare of the children is similarly affected. The high level of anaemia among pregnant and non-pregnant women, combined with carrying heavy loads is apt to hamper the growth of the foetus and reduce the quantity and quality of maternal milk of the prospective mothers[117].

Among the surveyed households, time spent for collecting firewood ranged between 1 and 5 hours daily, the distances to walk there ranged between 1 and 10 km. Several households confirmed that they hire donkey charts to bring the deliver the collected wood in order to reduce time for transportation. Prices paid for fuel wood include these transportation fees.

b) Peri-urban households

As described in chapter 1.8, sanitation programmes to achieve the MDG are underway. Within these programmes, at least 40,000 on-site flush toilet systems will be installed in the peri-urban areas of Ouagadougou and in the 13 regional and 45 provincial capitals. Constructing biogas plants (biogas septic tanks) instead of simple - often unsealed - septic tanks could benefit customers and the environment.

c) Small scale food processing industry

Food processing like drying or beverage production produces a lot of waste while at the same time energy input or the transformation process is required. Especially in the southern fruit production regions biogas plants could be a viable solution for resolving both problems.

d) Livestock markets

Ten regions maintain at least one livestock market for different purposes. On these places periodically high amounts of dung are produced.

[117] F.B.T.R.D: Les utilisations des moyens intermediaries de transport au Burkina Faso, 1999

Table 32: Livestock markets in Burkina Faso

Region	Place	Type	Frequency
Boucle du Mouhoun	Bena	breeder market	weekly
Centre	Ouaga-Tanghin	consumer market	daily
Centre	Ouaga-Abattoir	consumer market	daily
Centre-Est	Pouytenga	consumer market	every 3rd day
Centre-Nord	Kaya	cooperative market	every 3rd day
Centre-Nord	Yilou	breeder market	every 3rd day
Centre-Ouest	Tô	breeder market	every 6th day
Est	Fada N'Gourma	consumer market	weekly
Hauts-Bassins	Bobo-Colma	consumer market	daily
Hauts-Bassins	Bobo-abattoir	consumer market	daily
Nord	Youba	cooperative market	every 3rd day
Sahel	Djibo	cooperative market	weekly
Sahel	Gorom-Gorom	breeder market	weekly
Sud-Quest	Nadiabonly	breeder market	weekly

e) Slaughterhouses and abattoirs

Slaughterhouses are managed at community level, so it could be counted with at least 350 small scale slaughterhouses where at least once a week cattle and goats are slaughtered. Following Muslim traditions, pigs are rendered separately, but have to be brought to the abattoir in order to be checked and certified by the veterinary service.

3.4.2 Needs to be addressed

Energy is a key for meeting basic needs:

- Domestic uses (cooking and lighting)
- Household tasks (pumping, grinding, milling)
- Productive purposes (brick and ceramics firing, metal working, fish smoking, milling, cloth making, baking)
- Social services (health care, education)

Lack of access to energy affects women and girls disproportionately:[118]

- Health: carrying tens of kilos of fuel wood over long distances; indoor air pollution
- Literacy: girls kept away from school
- Fertility: illiteracy increases family size while work load risks maternal health
- Safety: household fires, personal attack during wood collection

Furthermore, all potential biogas customer groups would have significant similar needs

- for reliable and economic energy fuel for cooking, lighting, food processing and food conservation (drier, refrigerators)

[118] Yager, A. UNDP: The Role of Cleaner Fuels in Poverty Reduction, 2006

- for improvements in sanitation facilities, waste water and organic waste treatment, and overall health conditions
- for economically accessible and ecologically safe fertilizer to restore and maintain soil fertility

3.4.3 Benefits expected from a biogas plant for potential clients

a) Small farms and rural households

- Energy: cooking, lighting, food conservation
- Saving of firewood: environmental protection through reduced deforestation
- For women and girls: less time for fuel wood collection, reduced vulnerability in terms of health risks, increased time for other activities (e.g. use of health service, income generating activities, literacy programmes etc.)
- Agricultural improvements in plant and animal production yields: improved nutrition and increased household income
- Fertiliser production with subsequently protection and/or recovery of soil fertility
- Sanitation: controlled disposal of animal manure and organic waste; grey water collection and reuse; improved hygiene and sanitary conditions in the household
- Health: reduction of diseases related to waste water and solid waste; reduction of exposure to smoke and flue-gas during to cooking hours
- Modernity: clean and efficient fuel
- Climate protection

b) Small scale food processing industry

- Energy: hot water; transformation and conservation; production of renewable electricity; reduction of energy bill
- Saving of fuel wood: environment protection through reduced deforestation
- Sanitation: controlled treatment and discharge of waste water from processing and cleaning; controlled treatment and discharge of organic waste; controlled treatment and discharge of animal waste
- Fertiliser production as additional income potential
- Modernity: clean and efficient fuel
- Climate protection

c) Peri-urban households

- Energy: cooking, lighting, food processing and conservation, saving of energy expenditures
- Savings in fuel wood: environmental protection by reduced deforestation
- Sanitation: controlled discharge and treatment of waste water, controlled discharge and treatment of organic waste
- Recycling of sanitation sub-products: organic matter and water: Urban environment improved by parks, flowers, trees
- Modernity: clean and efficient fuel

- Groundwater and climate protection

d) Livestock markets, Slaughterhouses and abattoirs

- Energy: heating, cooling, lighting
- Saving of energy expenditures
- Savings in fuel wood: Environmental protection by reduced deforestation
- Sanitation: Controlled discharge and treatment of waste water, controlled discharge and treatment of organic waste, less fly and vector breeding
- Modernity: clean and efficient fuel
- Groundwater and climate protection

The thermal kWh potential generated by biogas also differs significantly from region to region:

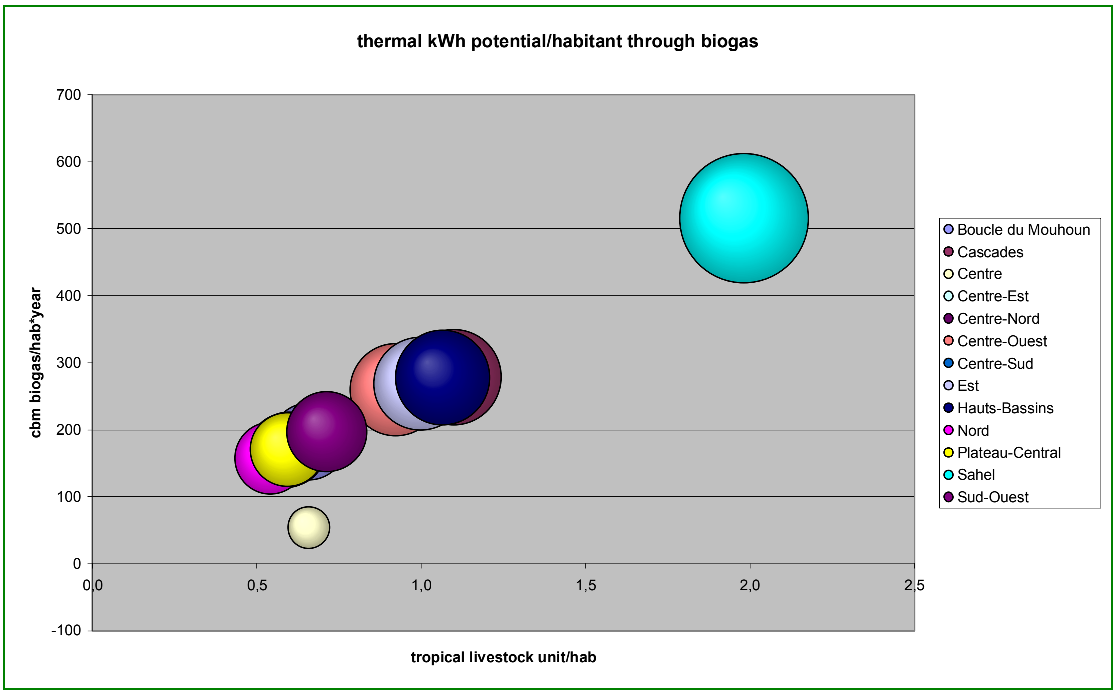


Figure 8: Regional thermal kWh potential generated by biogas

3.4.4 Targeted geographic area

For geographic area selection and recommendations where to start the NDBP, the theoretical biogas potential and the above mentioned criteria of (i) livestock husbandry system: zero or semi-zero grazing, (ii) compost programs, (iii) livestock trade have been considered.

Table 33: Selection of regions for start-up of NDBP

Region	Households *(10 persons)*	Tropical livestock unit / household	Husbandry system*	Compost programs**	Livestock trade***
Sahel	91,074	19.68	T & S	Y	coop & b
Cascades	52,496	10.81	S & Z	Y	-
Hauts-Bassins	134,844	10.36	S & Z	Y	cons
Est	110,526	9.77	T & S & Z	Y	cons
Centre-Ouest	*109,780*	*8.74*	*T & S*	*N*	*b*
Sud-Ouest	62,405	6.85	S & Z	Y	b
Boucle du Mouhoun	*144,464*	*6.30*	*T & S*	*N*	*b*
Centre-Nord	*112,999*	*5.73*	*T & S*	*N*	*coop & b*
Plateau-Central	*78,580*	*5.70*	*T & S*	*N*	-
Centre-Est	*103,278*	*5.63*	*T & S*	*N*	*cons*
Centre-Sud	*72,966*	*5.61*	*T & S*	*N*	-
Nord	*115,240*	*5,18*	*T & S*	*N*	*coop*
*Centre**	*260,955*	*0.93*	*S & Z*	*Y*	*cons*

** husbandry system: t = transhumance; s = semi-zero grazing, z = zero grazing*
*** compost programs: y = yes, n = no*
**** livestock trade: b = breeder market, cons = consumer market, coop = cooperative market*

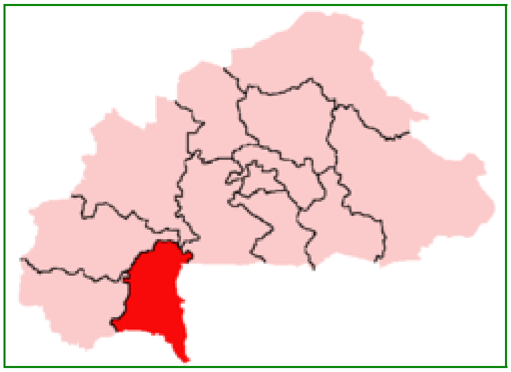
Regions with a TLU/habitant below national average of 0.8, with no registered or only consumer oriented livestock trade, no recognized compost program and a general livestock husbandry system between transhumance and semi-zero grazing have been discarded as priority start-up regions without leaving them out of consideration for the nationwide information and publicity campaigns. This group includes the regions Centre, Centre-Sud, Centre-Est and Plateau-Central.

In order to facilitate all benefits of a biogas plant, the presence of a compost promoting programme has been weighted above the presence of livestock trade. Therefore the following group of regions is not recommendable as start-up regions of the NDBP: Nord, Centre-Nord, Boucle du Mouhoun, and Centre-Ouest.

Among the remaining regions – Sud-Ouest, Est, Hauts-Bassin, Cascades et Sahel – those where zero-grazing is already practiced should be selected as preferred start-up regions. However, the Study Team had been informed, that also in Sahel region NGOs are already working to introduce zero grazing systems[119].

[119] AGED, oral information, April 2007

Sud-Ouest



Created on 2 July 2001, the region's capital is Gaoua. Four provinces make up the region - Bougouriba, Ioba, Noumbiel, and Poni.

PDA/GTZ is working in the region aiming to reduce poverty in rural areas, by supporting capacity building of farmer for improvements of agricultural activities, including zero and semi-zero grazing systems, fattening techniques and compost use.

Total theoretical biogas potential amounts to 122.80 Mio m3/y. Out of the 62405 rural households with an average TLU of 6.85 at least 12481 could be estimated as potential biogas clients. The region hosts a livestock market for breeders. In 2005, 287,120 cattle and 261,319 pigs have been raised. 6,277 cattle have been exported.[120]

In the region, pig fattening has been introduced and managed by the very active Women Promotion Group APFG[121]. The president of this group declared high interest in biogas technology and would likely take over the awareness raising and marketing part. This association manages also an internal micro-credit program for its members who can benefit from amounts up to 500,000 FCFA for setting up small enterprises. Pay-back period is 1 year; as guarantee 25% of the credited sum rests with the association.

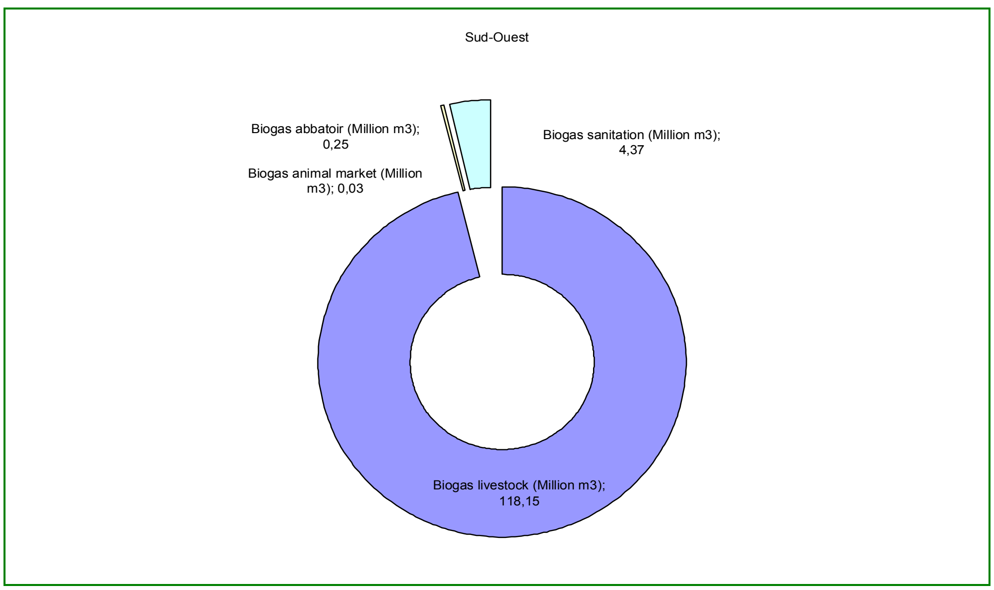
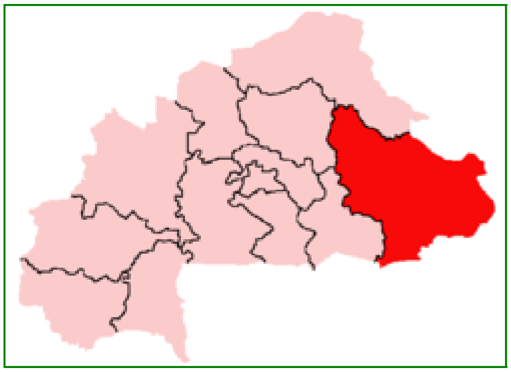


Figure 9: Biogas potential in Sud-Ouest region

[120] MRA Enquete 2005
[121] Association pour la Promotion des Femmes a Gaoua

Est



Created on 2 July 2001, the region's capital is Fada N'gourma. Five provinces make up the region - Gnagna, Gourma, Komondjari, Kompienga, and Tapoa.

PICOFA, a national program for the restitution of soil fertility, and PDA/GTZ introduce improved livestock and agricultural technologies in the region. Composting pits are already well accepted.

Total theoretical biogas potential amounts to 296.90 Mio m3/y. Out of the 110,526 rural households with an average TLU of 9.77 at least 22105 could be estimated as potential biogas clients. The region hosts a livestock market for consumers. In 2005, 864,811 cattle and 108,486 pigs have been raised. 21,495 cattle have been exported.[122]

In the region, cattle and pig fattening is introduced and managed by local associations like FIIMBA and APB[123]. These associations would likely take over the local awareness raising, training and marketing part of the NDBP. They also manage internal micro-credit programs.

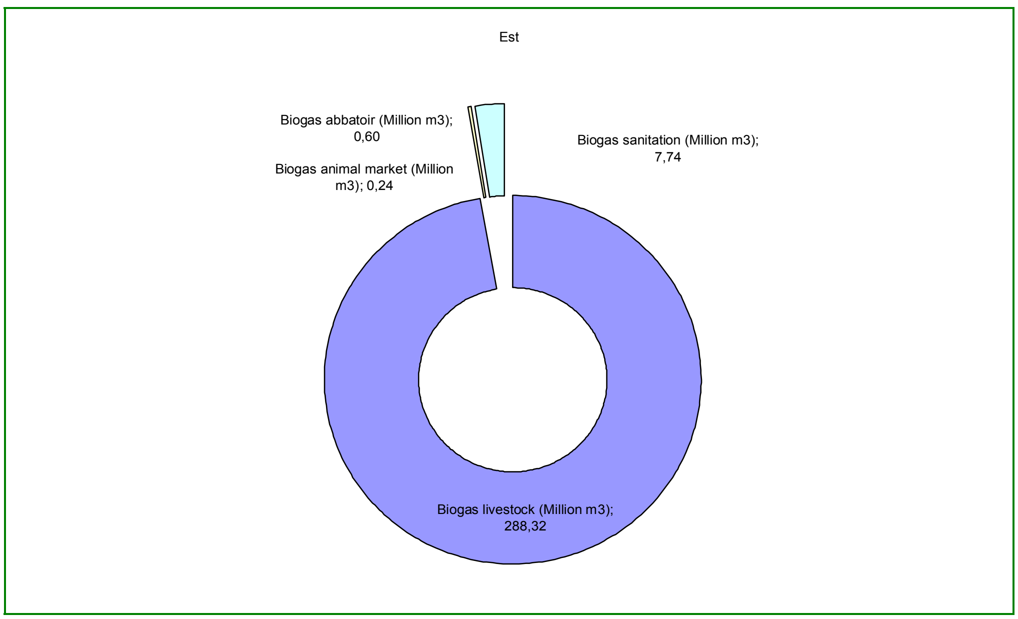
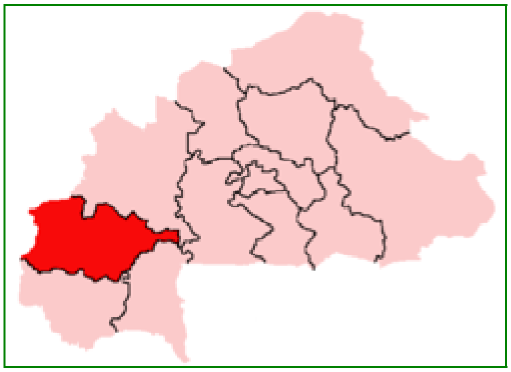


Figure 10: Biogas potential in Est region

[122] MRA Enquete 2005

[123] FIIMBA: local association for improved agriculture, livestock and micro-finance; APB – Association Piela – Bilanga: local association working in sanitation, organic agriculture and social, ecological and economical development

Hauts-Bassins



Created on 2 July 2001, the region's capital is Bobo Dioulasso. Three provinces make up the region - Houet, Kénédougou, and Tuy.

With KFW and national funds, the PABSO program is introducing advanced technologies for the appropriated management of agricultural soils. The region is rich in animal resources: In 2005, over 1.2 Mio cattle have been registered, and more than 28,000 exported.

221,408 pigs and about 4 Mio poultry have been raised. Therefore the theoretical biogas potential is calculated at 374 Mio m3/y. Among the 134,844 rural households at least 26,968 should be seen as potential clients in the NDBP.

The region hosts two daily operating livestock markets in Bobo-Dioulasso and Bobo-Colma. The region has large agricultural biomass from fruits and vegetable plantations, which supply also European markets.

SNV maintains an office in the region’s capital, focussing in supporting the communities to benefit socially, ecologically and economically from decentralization. NDBP could probably count on the SNV local and technical expertise.

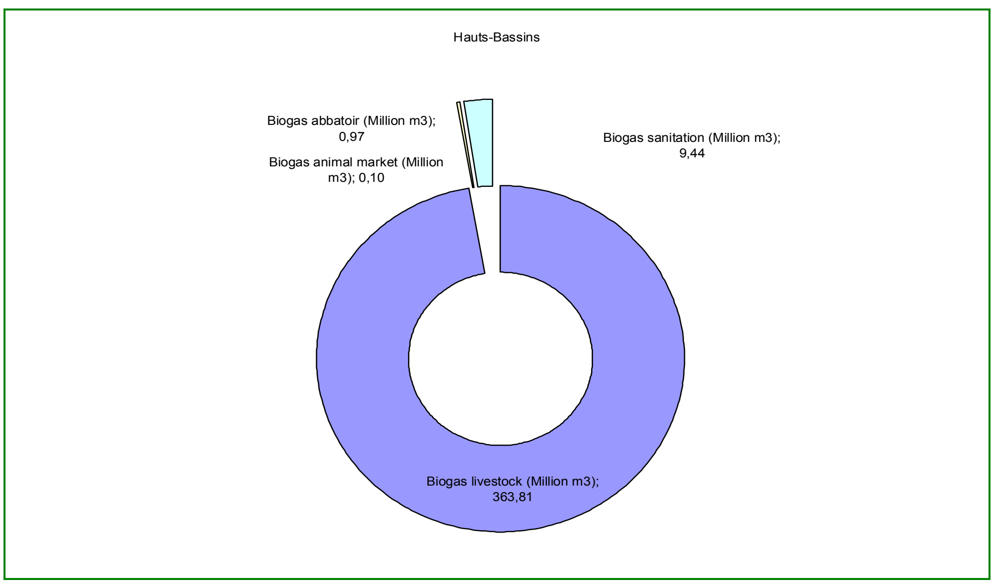


Figure 11: Biogas potential in Hauts-Bassins region

Cascades

Created on 2 July 2001, the region's capital is Banfora. Two provinces, Comoé and Léraba, make up the region.

The region hosts the National Water & Forest College ENEF [124], the first high level environmental school in the West African Region, which has been founded already in 1953. The college performs as a knowledge hub: its international students are future environmental professionals in governments and enterprises.

Although there is no officially registered livestock market in the region, Cascade has a large livestock population of over 500,000 cattle; only 44,500 pigs have been registered in 2005. Official animal export is not very common. At least about 10,499 households are estimated to have the potential for participation in the biogas programme. biogas

Theoretical biogas potential amounts to 145.77 Mio m3 per year.

Promotion and training partner in the region for the country and the West African Region should be ENEF, for 2 reasons: (i) in the compound a biogas batch system has been installed and used in the eighties, (ii) the school trains professionals for the environmental administration. In the curriculum waste water treatment technologies are already included, but would benefit from any update – according to information received on-site[125].

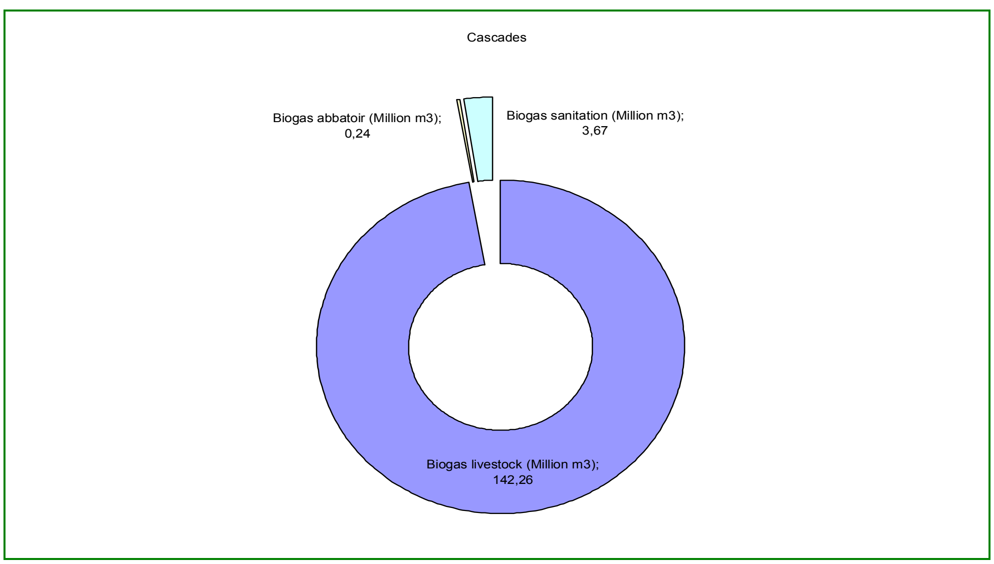
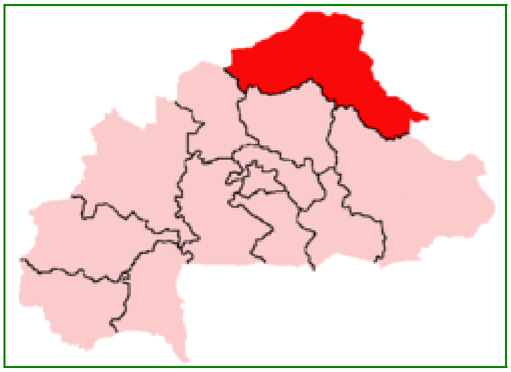


Figure 12: Biogas potential in Cascades region

[124] Ecole Nationale des Eaux et Forets
[125] ENEF, oral information April 2007

Sahel



Created on 2 July 2001, the region's capital is Dori. Four provinces make up the region - Oudalan, Séno, Soum, and Yagha.

The region, well know for its environmental vulnerability, is home of 910,000 people and 1.56 Mio cattle, 1.8 Mio goats and 1.2 Mio chicken. Camels, horses, and donkeys, sheep and a limited number of pork count for another 1.1 Mio of animal resources[126].

Transhumance is still the most popular livestock husbandry system, but slowly changes take place: AGED[127] in cooperation with INERA, local associations and international donors is introducing since several years now livestock husbandry technologies which tend to be sustainable in the Sahel context. Most important aspect is the integration of agriculture and livestock to benefit from manure production for soil fertility, food and fodder production and village development.

This local NGO would be interested to promote the NDBP in the Sahel region, given the fact that probably 18,214 households could be potential clients for biogas plants.

The theoretical biogas potential in the Sahel region is calculated at 469.69 Mio m3 per year.

In the region, two livestock markets operate on a weekly basis, both focussing on professional trade specifically of cattle and goats. In 2005, about 11,000 cattle and 37,000 goats have been exported.

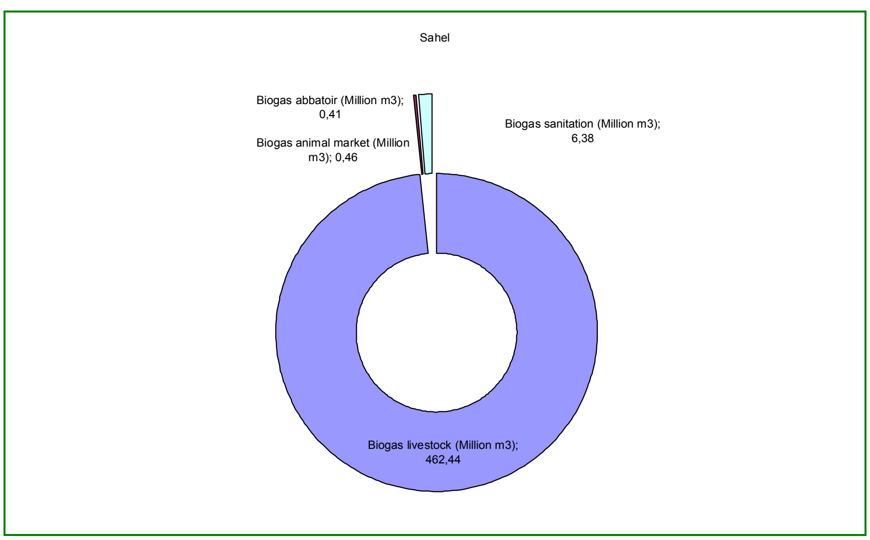


Figure 13: Theoretical biogas potential in Sahel region

126 MRA, Enquete 2005
127 Agence de Gestion ecologique et durable, NGO based in Ouagadougou and Dori

3.4.5 Estimated market size & expected sales levels

Based on the results of interviews, visits, statistical analysis and the Rapid Household Survey, which all have been screened according to the (i) availability of biomass, (ii) infrastructure for household and livestock (iii) water, and (iv) economic potential, market size and sales levels are estimated.

Table 34: Rural households and farms in start-up regions

Region	Rural Households	Potential Clients
Hauts-Bassins	134,844	26,968
Est	110,526	22,105
Sahel	91,074	18,214
Sud-Ouest	62,405	12,481
Cascades	52,496	10,499
Potential for NDBP		**90,267**

Table 35: Peri-urban households

Sector	Total number	Potential Clients
Sanitation & wastewater treatment	40,000	20,000
Potential for NDBP		**20,000**

Table 36: Registered food processing units

Sector	Total number[128]	Potential Clients
Alcoholic Beverages	4	1
Fat and Oil	38	19
Fruits and Vegetables	35	17
Meat and Dairy products	57	28
Potential for NDBP		**61**

Table 37: Slaughterhouses, abattoirs & livestock markets

Facility	Total number	Potential clients
municipal slaughterhouses	350	175
Livestock markets	14	7
Potential for NDBP		**182**

Table 38: Not registered small associative food processing units

Facility	Total number	Potential clients
Household based fruit driers, sesame processors, and others, estimation goes to ….	2,000	1,100
Potential for NDBP		**1,100**

[128] registered in 2007 at Burkina Faso Chamber of Trade, Industry and Handicraft

Table 39: Projected installation of biogas plants according to NDBP implementation schedule

Year	2008	2009	2010	2011	2012	2013	2014	2015	2030
Phases	Start-up phase		Implementation phase						
Steps	0	I	II	III	IV	V	VI	medium term	long term
Demo	50	50							
Rural households		250	1,000	2,500	3,000	3,500	3,750	14,000	90,267
Peri-urban households		100	400	1,000	1,500	3,000	4,000	10,000	20,000
Agro-business		100	120	160	170	200	250	1,000	1,343
Total	50	500	1,520	3,660	4,670	6,700	8,000	25,000	111,610

Table 40: Conservative & optimistic long term market estimation until 2030

Target customer group	Conservative market estimation	Optimistic market estimation
Rural households & farms	90,267	180,534
Peri-urban households	20,000	35,000
Registered food processing units	61	102
Slaughterhouses, abattoirs & livestock markets	182	300
Not registered associative food processing units	1,100	1,700
TOTAL	**111,610**	**217,636**

Box 8: Potential biogas clients, not included in market size estimation

- *Large demonstration dairy farms (about 13)*
- *Potential of 7,000 community biogas systems close to existing water points (22,700 boreholes + 7,300 wells in rural areas)*
- *Possible biogas systems connected to public toilets (schools, markets, health centres: about 5,000 sites)*
- *Sanitation Plan for urban areas: 220,000 on-site or community flush toilet systems*
- *16,000 pig fattening units in peri-urban areas*

3.4.6 Competition in the energy & fertilizer market

a) Energy market

The rural household energy market is dominated by fuel wood, charcoal, kerosene and batteries. Solar energy home systems are not yet well accepted due to fairly high prices of the equipment, and LPG distribution encounters still logistic problems.

LPG comes along with an image of modernity: young governmental employees use bottled gas. Latest news from the LPG sector indicates that SONABHY[129] has invested with governmental support in infrastructure and modernization to achieve the consumption of 20,000 t of LPG in 2010. Starting in 1994 with 3,000 t, market penetration in 2006 is reported at 16,000 t, about 13,800 t distributed in Ouagadougou[130].

Household biogas has no commercial value, as it could not be sold to the neighbourhood. Thus it is to be compared economically with other conventional sources of fuel which are free of charge, like fuel wood and agricultural residues.

Table 41: Price comparison for fuel for cooking and lighting based on data from Rapid Household Survey 2007

Sample	Fuel	Users (%)	Average amount used per year	Average Cost per user per year (FCFA)
100	firewood	61	10,33 donkey charts	33,075.00
	charcoal	27	21,85 40-kg-sac	15,423.67
	LPG	7	9,29 12-kg-btl	15,857.71
	Kerosene	65	31,04 litre	16,421.54
	Electricity	9	No exact data	30,467.11
	Batteries	69	86,25 pieces	41,109.12

Traditionally firewood is so to say free of charge, and its supply is only an investment in women's time. Increasing numbers of women however encounter problems in collecting firewood close to their homestead. They have to invest more time now walking 2 – 10 kilometres whereas previously only some minutes were needed. Some communes have already introduced tariffs for fuel wood; others have introduced a tax on wood collection.

Charcoal availability is reduced and production has been limited by law, as the production of charcoal has lead massive deforestation.

Energy for lighting in rural areas is predominantly provided by kerosene lamps or torches. Kerosene for lighting purpose is subsidized by the government; but still energy resources for lighting are expensive, which fail to provide a comfortable, reliable, healthy light.

[129] Societe Nationale Burkinabe des Hydrocarbure
[130] http://www.lefaso.net 21.06.2007 : Protection de l'environnement : 16000 tonnes de gaz consommes en 2006

b) Fertilizer market

Market for organic fertiliser exists mainly in those places where programmes like PICOFA or PDA/GTZ are introducing compost pits. Households in need of fertilizer, pay up to 2000 FCFA per ton of dung, which is also sometimes collected by children returning from school.

Chemical fertilizer is generally provided to cotton producers as loan. They have to pay it back in harvest time.

3.4.7 Critical market risk factors

Technological design should not be imposed: People could be best convinced by knowledge transfer and perfect biogas plant performance. Market risk factors could be encountered as soon as the product “biogas plant” would not fulfil the publicity promises, i.e. insufficient gas production, bad performance of gas appliances, additional work load for household members.

It is therefore indispensable to install and maintain a permanent quality control and to teach the users how to make best benefit out of their biogas plant. NDBP should take care for viability, not for cheapness, in order to conquer and maintain the market.

4 Implementation strategies for a National Domestic Biogas Programme in Burkina Faso

The use of traditional fuels results in respiratory disease from indoor and local air pollution, drudgery, reduced productivity, land degradation and constrained income-generation. A readily available, clean-burning modern energy carrier like biogas is one option to support sustainable rural development. Biogas has demonstrated health and environmental benefits compared to traditional fuels; however, availability of skilled technicians, financing of first costs and learning processes of users could be barriers to the NDBP implementation.

Strategies have therefore to consider that technology – even if proven and matured - is not the only ingredient for increased energy equity. New institutional measures and financing mechanisms to cover initial capital costs of installations, devices and equipment are requested within a National Domestic Biogas Programme. It would be most successful when combined with other policies. Local population must be involved not only as potential customers, but also as multiplicators and programme owners.

Box 9: Changes in the Renewable Energy Sector approach

Old paradigm		New paradigm
Technology assessment	➔	Market assessment
Equipment supply focus	➔	Application, value-added, and user focus
Economic viability	➔	Policy, financing, institutional, and social needs and solutions
Technical demonstrations	➔	Demonstrations of business, financing, institutional and social models
Donor gifts of equipment	➔	Donors sharing the risks and costs of building sustainable markets
Programs and intentions	➔	Experience, results, and lessons [131]

4.1 National programmes and objectives related to NDBP

Burkina Faso subscribed to a number of intentional commitments, with regard to climate and environmental issues. The government of Burkina Faso has ratified the ***United Nations Framework Convention on Climate Change - UNFCC*** in 1993, and approved its Stratégie Nationale de Mise en Oeuvre de la Convention sur les Changements

[131] Martinot, E. et al, RE Markets in DC, 2002

Climatiques in 2001. After having ratified the ***Kyoto Protocol*** in 2005 [132], the Government has recently established the Designated National Authority (DNA), whose contact is: The Secrétariat Permanent du Conseil National pour l'Environnement et le Développement Durable (SP/CONEDD), Avenue Bassawarga, 01 BP 6486 Ouagadougou 01, Burkina Faso (spconedd@yahoo.fr / spconedd@fasonet.bf).

To trigger interventions and boost progress to achieve MDGs, many actions have been initiated at the political level. For a better coordination of these interventions at the national level, policies and plans are elaborated in the frame of the Poverty Reduction Strategy Paper (PRSP). According to this document, a sustainable provision of energy of the rural areas (wood energy, electricity, like modern fuel) as well as access to drinking water, food safety, health, healthy agriculture, and biodiversity must be guaranteed. Therefore, basic prospects for an improvement in the quality of life, particularly for poor populations, should be encouraged and supported. National authorities are also committed to regularly produce the MDG country report, in order to assess progress towards the MDGs and/or plan corrective actions. The last report was published in 2003.

To translate and apply plans and policies at the national level, Burkina Faso, with the assistance of its financial partners, has established several national development programs, according to sectors and priorities. In the frame of a future NBDP, national programs in terms of environment, energy, and health, hygiene and sanitation, could be of great interest.

4.1.1 Environment and climate

To meet the MDGs, the Government of Burkina Faso has specific programs which are likely to accelerate the protection and the rational management of the natural resources:

- Plan d'Action Forestier Tropical du Burkina Faso (PAFT-BF)
- Plan National d'Action Pour l'Environnement (PNAE)[133], integrating the PNLCD (Plan national de lutte contre la désertification) and the PNGTV (Programme National de Gestion des Territoire Villageois).
- Programme "8000 villages, 8000 forêts- une école, un bosquet".
- Programme National de Gestion des Terroirs (PNGT);
- Programme de Gestion des Ressources Naturelles (PGRN);
- Programme de Développement Local (PDL) ;
- Programme de Gestion Durable des ressources Forestières (PROGEREF)
- The United Nations Convention on desertification control; its objective is to fight against desertification and to mitigate the effects of drought.
- The Convention Framework on Climatic Changes whose objective is to stabilise green house gas concentration in the atmosphere

With the support of UNDP, several other programs are being implemented throughout the country:

- Auto-évaluation des besoins de renforcement des capacités nationales pour la gestion de l'environnement mondiale

[132] http://maindb.unfccc.int/public/country.pl?country=BF
[133] Kimsé Ouedraogo (2001) - L'étude prospective du secteur forestier en Afrique(FOSA) – Le Burkina Faso

- Programme de partenariat pour la gestion durable des terres
- Programme d'actions national d'adaptation aux changements climatiques
- Auto-évaluation pour la préparation de la seconde communication nationale sur les changements climatiques
- Programme d'Amélioration des Revenus et de Sécurité Alimentaire (ARSA) pour les groupes vulnérables

All these programs aim to ensure a safe environment and to reduce the impact of climate changes and of desertification. They give priority to forest management through reforestation, the diffusion of the improved equipment and by attempting to tackle the question of wood fuel to reduce the pressure on natural resources.

The general objective of the environmental and climate policies and plans is the research of a socio-ecological and socio-economic balance able to contribute to food self-sufficiency, with the satisfaction of the national requirements in energy, in order to offer the best living conditions to the populations. The observations made during the study in Burkina, show that these programs/actions could be further reinforced through a NDBP.

4.1.2 Energy

- The Regional Program for the Review of the Traditional Energy Sector (RPTES) was established in recognition of the impact that the traditional energy sector policy has on environmental sustainability, rural poverty alleviation, energy and economic efficiency, and gender equity in developing countries.
- The program GAZ of the Permanent Interstate Committee For Drought Control in the Sahel (CILSS) made it possible to introduce practices for the use of butane gas - even if this remains weak in rural area.
- The National Wood Strategy[134] states that a strategy should be developed aiming at reducing the pressure on overexploited zones, using economic policies at consumer level but also by a policy of substitution between fuels.
- The most ambitious regional program in the field of energy is the ***ECOWAS White Paper for a regional Policy in the energy sector***[135]**,** which was developed and adopted by the UEMOA countries in January 2006. This document actually serves as reference for all country members, including Burkina. The document[136] gives a review of the current energy situation, and names strategies to increasing access to energy services in peri-urban and rural areas.
- The ***National Multifunctional Platform Program***[137], whose aim is to create 400 Platform enterprises which will provide sustainable and affordable energy services to rural clients (at least 500,000 people) and about 4000 employments by 2007, thus providing more possibilities to increase income, consumption, to enjoy safe water and increase living standard. This program is strongly supported

[134] Stratégie Nationale Bois
[135] ECOWAS White Paper http://www.energy4mdg.org/spip.php?lang=en
[136] Monographie Burkina http://www.energie-omd.org/IMG/pdf/cedeao-monographie_burkina.pdf
[137] La Plate-Forme sur le terrain au Burkina Faso: http://www.ptfm.net/old/burkina1.htm#historique

by the Government, and by the UNPD at regional level covering 12 countries in Africa[138].

The application of these programs has currently had little impact in terms of energy provision and services, particularly in rural areas. With further development of renewable energy such as solar energy, biofuel and biogas, these programs could considerably contribute to an increased modern energy supply in rural areas, and to the preservation of the forest.

4.1.3 Health, hygiene and sanitation

- The Plan National de Développement Sanitaire 2001-2010 is the practical translation of the National Strategy for Health, in accordance with the National Policies for Public Hygiene. One of its objectives is to tackle the transmission of vector-borne diseases through a healthy environment.
- Programme National d'Approvisionnement en Eau Potable et d'Assainissement à l'horizon 2015. In terms of sanitation, this program aims to reach sanitation coverage of about 54 % in rural areas and 57 % in urban areas, through the installation of adequate facilities. In rural and semi-urban zones, the construction of up to 400 000 latrines/toilets is planned. An estimated 10 % of these will be with manual flush. This means possible implementation of about 40,000 septic tanks. In urban areas, it is expected to install 220,000 toilets by 2015.
- Programme Eau et Assainissement, co-financed by the European Union, with its ecological sanitation component, aims to reach 300,000 people, in terms of ecological sanitation.

4.1.4 Contribution of a future NDBP

With regard to the objectives of these programs to be realised, a future NDBP has a key role to play. Biogas units could easily replace septic tanks planned for wastewater treatment. Biogas units with attached toilets appear thus to be a suitable sanitation option for the country.

With the application and popularisation of biogas, labour used to collect firewood could be saved and deforestation stopped. Clean energy utilization frees rural women so that they can spend more time for literacy, health care and other generating income activities.

The application of liquids and solids from biogas tanks can improve agricultural production (yields) and avoid environmental pollution caused by chemical fertilizer. Additionally, biogas digesters could play an important role in treating excrements from farmers, live stock and poultry so that firewood piles and haystacks as well as dunghills are eliminated. As a result, rural areas should benefit from improved sanitary conditions.

Moreover, biogas technology offers further economic advantages. For example, a 10-person household with 2 Tropical Livestock Units using a domestic biodigester of 6 m3 size could make substantial savings in terms of energy costs: 5.4 tons/year of wood fuel and 0.24 tons/year of charcoal for cooking amounts to 42,720 FCFA/year; 18 litre/year of kerosene for lighting requires 11,340 FCFA.

[138] Launch of a Regional Programme: http://www.ptfm.net/old/mfpregionalcell.htm#launch

Using biogas for cooking reduces the need for fuel wood and charcoal. Each biogas unit is estimated to reduce deforestation by 37 hectares per year. Since it also uses cow dung that would otherwise have degraded, further greenhouse gas emissions are avoided[139].

4.2 Actors in the formal and informal sector related to NDBP

As biogas plant construction in the past has been decided and carried out in a very limited number of sites and systems, a country programme needs to develop a “Biogas Network” consisting of governmental, civil society and private sector partners:

- Looking at the environmental, agricultural and animal husbandry sectors, the government is represented until the third administration level through Provincial Departments. Only the Ministry for Energy is missing at this level, as rural energy supply is the task of the individual household; in the urbanized centres the Municipality is responsible for maintaining the limited grid.
- In rural areas, Association of Residents, Farmers’ Grass Root Organizations and Women’s Groups are quite active in auto promotion: small income generating activities are promoted through group loans, improved agricultural and animal keeping techniques are disseminated by local NGOs in close contact with international development agencies. These local organizations play an important role for awareness raising and introduction of new technologies.

  The German Technical Cooperation through DED, GTZ-PDA and GTZ-IS is already working in rural areas promoting advanced techniques and agro-ecological systems, in which biogas plants would fit in. The German Financial Cooperation addresses the needs of the decentralized communities by supporting them through co-financing priority projects like schools, hospitals, water and sanitation projects.
- Construction enterprises are concentrated in Ouagadougou and Bobo-Dioulasso; in regional capitals like Fada N’Gourma, Gaoua and Diebougou however some entrepreneurs only engage trained masons and plumbers when they get a construction job to do. At village level, trained masons are hard to find; nevertheless, the opportunity to learn a job by being trained in the construction of biogas digesters aroused the interest of several interview partners.

While ultimately biogas plants will be installed and maintained at household level, there are still several advantages in supporting and / or creating village-level institutions and implementing the programme through them:

- Motivation and client identification are easier if an institution comprising members of the local community is involved in the process.
- Women’s participation in the programme, which will be essential due to their leading role in ensuring household sanitary conditions, is easier, if an institution operating at local level carries out the programme.

[139] GEF, UNDP (2001) Biogas Technology in Agricultural Regions, Tanzania: http://sgp.undp.org/download/SGP_Tanzania2.pdf

- Developing and managing a local repair and maintenance network – including training, construction, maintenance – could be facilitated by an already existing institution, which will have to receive training when starting the NBDP.

4.3 NDBP – outline

A rough overview on potential local and regional institutional and private sector partners for the NBDP in Burkina Faso is given below. The identification is based on visits, interviews and the Stakeholder Workshop in Ouagadougou on April 27th, 2007, where representatives of 30 institutions and enterprises participated. The sector division considers the five main chapters of the programme. The listed partner and supporting institutions have all been visited by the Study Team, and declared their general interest in acting actively in a future NDBP. All of them are presented in Annex 3.

Table 42: Outline and overview on programme strategies, partners and supportive structure

1a) Programme Management	1b) Steering Committee
GTZ, GTZ-IS / SNV / DED + national professionals responsible for each one of the 4 thematic chapters of the NDBP	Ministry for Environment and Livelihood Ministry of Mines and Energy Ministry of Agriculture, Water Resources and Fisheries Ministry of Livestock Resources Ministry of Health + 2 representatives of the financial sector + 2 representatives from private sector + 2 representatives from training chapter + 2 representatives from mass media & communication sector + 2 representatives from UN agencies (UNDP and FAO) + 2 representatives from civil society + 2 representatives from CIFAME and UEMOA

2. Financing	3. Awareness Raising and Marketing	4. Training and Private Sector Promotion	5. Standardization and Quality Control
Partner: Banks and Micro-Finance institutions: *BRS* *Réseau des Caisses populaires du Burkina (RCPB),* *BACB,* Support Structure: *PAMER* *FICOD* *MEBF* *UEMOA* *Local Associations like FIIMBA, APB,*	Partner: *DED* *FAO* *CREPA* *CRESA* *CRA* *CEAS* *EIER 2ie* *RTB* Support Structure: *Local Associations like FIIMBA, APB, APRET, AGED, ASDC, APFG, Te Biir Law*	Partner: *INADES* *AMPTO* *University Ouagadougou* *INERA* *CREPA* *2iE* *CNRST-IRSAT* *IPD/AOS* *FAO* Support Structure: *Rural training facilities like ARFA, ENEF* *Private enterprises and*	Partner: *IRSAT* *CREPA* *SONGTAABA* *LNSP* *UFR / SVT / UO* *BUMIGEB* *LNBTP* *ONEA* Support Structure *Rural training facilities like ARFA, ENEF* *PAMER* *Private enterprises*

APRET, AGED, APFG, Te Biir Law Control: *Tresor - CT Micro-Finance*	*Local Breeding & Agriculture Associations*	*local NGOs working in the RE sector, like: HILEC, MicroSow, GGY, CEAS, Eveil du Faso, INTELFAC,*	*and local NGOs, like: HILEC, CEAS, MicroSow, Eveil du Faso, INTELFAC, GGY*

4.3.1 Programme management & political support

The establishment of a coordination body for the institutional networking of the NDBP is essential for market penetration and the achievement of the overall goals. The Consultants therefore suggest implementing a “Programme Steering Committee (PSC)” which conceptualizes the programme and provides political support to the “Programme Management Office (PMO)”.

a) PMO

It is proposed that the PMO will be established under the Ministry of Environment and Livelihood, as this Ministry is represented in all regions and maintains also provincial offices.

The PMO should be structured in accordance with the 4 thematic chapters of the NDBP. National and international professionals will work together in the PMO in order to share knowledge and provide the highest degree of accessible national and international expertise. It is recommended to run the PMO during the first phase of the NDBP with international expertise from GTZ, GTZ-IS, DED and/or SNV. This inclusion would help to set up alliances throughout the country in all these regions and programmes wherever GTZ, GTZ-IS, DED and SNV are already working, and influence directly the international donor community.

Main tasks of the PMO will be

- to develop mechanisms and procedures for programme implementation,
- to initiate the programme by identification of adequate actors and establishing MoUs with partner institutions in all 4 thematic chapters,
- to define responsibilities for required activities such as marketing, training, financing and construction,
- to provide administrative support to all 4 thematic chapters once NDBP implementation takes off,
- to support appropriate site selection for the first 100 biogas digesters for marketing and training purposes,
- to promote the elaboration of procedures for standardization and certification,
- to determine methodologies for quality control and M&E,
- to promote the development of subsidies, micro-finance mechanisms and requested support programs for different target groups.
- to provide the PSC with updated information about progress and barriers of NDBP implementation.

b) PSC

The responsibility for setting up and maintaining the PSC should be given to the Ministry of Mining, Carriers and Energy, as the initial focus of the proposed Biogas Programme is related to Renewable Energy generation at household level in rural and peri-urban areas. This Ministry is actively participating in the West African energy sector cooperation, but doesn't have offices at all national administration levels. The international cooperation may support the replication of the NDBP in neighbouring countries.

The PSC in itself will represent the multi-sector approach of the National Domestic Biogas Programme. Beside the involved ministries the PSC should unite representatives from partners in all 4 chapters, and should develop a strategy to integrate also the civil society, i.e. the local associations in its multi-institutional dialogue. Permanent and non-permanent members guarantee a flexible structure in order to act and react in-time on changing conditions and developments.

Main tasks of the PSC will be

- to create an enabling environment for NBDP implementation,
- to give policy support to the PMO,
- to elaborate strategies for massive dissemination of biogas technology in Burkina Faso and the West African region,
- to promote MoUs between political and civil society stakeholders and the NDBP,

4.3.2 Financing

a) Partners and their role

Chapter Financing will require strong partnership with national banking and micro-finance institutions. Their role will be

- Contribution to the development of NDBP subsidy schemes and micro-finance mechanisms in accordance with national laws, rules and regulations,
- Participation in the provincial committees for decisions on credits and subsidies,
- Support to local actors in quality control,
- Support to local actors with training in financial and business management

Potential partners have been interviewed during the Feasibility mission and are herewith presented. More details could be found in ANNEX 3.

Table 43: Potential NDBP partner for Programme Chapter "Financing"

BRS	Banque Régionale de Solidarité : Ouagadougou and UEMOA region wide New Bank institute with UEMOA funds, represented in all UEMOA member countries Credit system for programs/projects on poverty reduction, conservation of natural resources, agricultural development, including farm equipment, and consumer credits Given its presence at the regional level, the BRS could play an important role in the credit & subsidy system for biogas
BACB	Banque Agricole et Commerciale du Burkina Faso : Ouagadougou and country wide in regional and provincial capitals Bank institute with large network; Credit system for farmers, and consumer credits Given its presence at regional and provincial level, the BACB could play an important role in the credit & subsidy system for biogas

RCPB	Réseau des Caisses Populaires du Burkina : Ouagadougou – country wide at regional, provincial and even community level Bank institute with largest network; Credit system for farm equipment, and consumer credits Given its presence at each administrative level, the RCPB could play an important role in the credit & subsidy system for biogas

b) Support Structure and activities

Supporting structures in the Finance Chapter are expected to work from village level upwards and from national level downwards in a flexible manner. This requires strong coordination capacities, clear mechanisms and simple procedures. Several institutions are already in place to support the administrative decentralisation of the country. They have been contacted and agreed to give their support once the NDBP will require it.

Table 44: Potential NDBP supporters in the Programme Chapter "Financing"

PAMER	Projet d'Appui aux Micro-Entreprises rurales : Ouagadougou and the eastern and western regions Launched in 2001 with support of IFAD, PAMER aims to develop entrepreneurship in rural areas Capacity building and technical support to Small and Medium Enterprises in rural areas PAMER could play an important role in entrepreneurship development, capacity building and access to micro-finance, elaborating marketing strategies and in M&E
FICOD	Fonds d'Investissement pour les Collectivités Décentralisées : Ouagadougou – Gaoua – Fada N'Gourma Financial Cooperation Burkina Faso – Germany Co-Financing projects of priority selected by decentralized municipalities: market infrastructure, public services, social infrastructure In case municipalities would decide to implement biogas digesters as wastewater treatment plants, FICOD would join in the co-financing mechanisms
UEMOA	Union Economique et Monétaire de l'Afrique de l'Ouest : Ouagadougou, and West African Region Regional organisation, which aimed to initiate a pre-feasibility study on biogas potential in UEMOA members country Financing, fund raising; strategy recommendations for national policies; Potential partner for co-financing NDBP and feasibility studies in other UEMOA countries
FIIMBA, APB, APRET, AGED, APFG, Te Biir Law	Local associations – see Annex 4: country wide at village and community level Local partners for micro-finance administration

c) Control:

The Ministry of Finance and the national control authority have established a Technical Unit dedicated to control micro-finance schemes and systems. NDBP will cooperate with this governmental institution closely to guarantee financial management according to national laws and regulations.

d) Strategies

Governmental policies focussing on the substitution of fuel wood support the consumption of kerosene and LPG by tax reduction. This reduction concerns the “tax on petrol products (TPP)” and the “tax on added value (TVA)”. Meanwhile both kerosene and LPG are currently therefore accessible at a lower price than their real cost, this policy is under revision. As the UEMOA is installing huge regional energy supply schemes[140] which will lower the import bill for gas and hydrocarbons at a regional level, tax subventions at least for LPG are said to be stopped by end of 2007. Together with the end of the subsidies for LPG equipment paid in the framework of the Regional Gas Programme, price level for LPG will be as in the neighbouring countries[141] from 2008 onwards.

By financing large reforestation programmes the government subsidizes the use of firewood with 50 US$/cap/y[142].

Subsidies should target access to modern, clean fuels, not consumption. Subsidy schemes will have to reflect both private sector promotion and client support. It is proposed to look for economic support mechanisms which provide

- Small subsidies to operators in the field of training and follow-up, the development of biogas equipment and its promotion – these subsidies should not be repaid
- Tax reduction in TVA for producers of biogas equipment and constructors of biogas plants
- Micro-credits for producers of biogas equipment and constructors of biogas plants
- Micro-credits for biogas customers

In Burkina Faso, micro-financing is well established and practised by local associations, particularly empowering women’s groups to undertake income generating activities. Given the group as “pay-back-security” the experiences are very positive. The Study Team received conforming information in different places like Bogande[143], Gaoua[144], and Piela[145].

[140] WAPP and WAPG
[141] MMCE, oral Information, April 2007
[142] MMCE, oral Information, April 2007
[143] FIIMBA, oral information April 2007
[144] APFG, oral information, April 2007
[145] APB, oral information April 2007

Moreover, the RCPB covers the whole county and is accessible for farmers also in relatively remote areas. The institution has a credit system in place which allows farmers to purchase agricultural tools, vehicles and other goods at an interest rate of up to 10%.

Both the subsidy scheme and the micro-credit system have to be developed considering the life time of a biogas installation, the quality guarantee given by the constructor, his after-sales services, and the user's participation in biogas raining events.

4.3.3 Awareness raising and marketing

Household energy needs are met largely by women and girls. Fuel collection limits girl's participation in school, impact literacy, fertility and economic options. Clean fuels like biogas reduce drudgery by saving time for fuel wood collection and also free time for productive purposes. Together with these benefits, health and environmental benefits should be in the centre of any awareness raising and information campaign at the beginning of the National Domestic Biogas Programme (NDBP).

Already from the start, the NDBP programme policy should not be gender neutral as this would probably end in a "gender blind" energy programme. As women and girls are the key energy manager at household level, all campaigns should address their needs and situation.

As soon as good quality services in construction and after-sales-visits are offered by the private sector, the NDBP could rely on word-of-mouth promotion. Anyhow, this will not be sufficient for massive dissemination of biogas plants. Given the weak economic structure of private enterprises in the RE sector, the NDBP will have to take care of large promotion campaigns by its own budget involving professional media enterprises, thus creating a demand which will be covered by the private sector's offer.

After several years the cost of a biogas plant should cover also promotional costs for maintaining an ongoing publicity campaign.

Without any doubt, the NDBP will receive partnership and support for awareness raising, information and publicity and marketing both from national and international organizations and local social development associations, breeder groups, and organic agricultural movements.

Table 45: Potential NDBP partner for Programme Chapter "Awareness raising & Marketing"

DED	German social and technical service in development, Ouagadougou and countrywide Capacity building in local communities; very potential NDBP implementation partner for coordination, training, awareness raising, marketing strategy
FAO	UN-Food and Agriculture Organization, office Ouagadougou
SNV	Netherland Volunteer Service, Ouagadougou and country wide; Social, ecological and economical consultancy to communities; very potential implementation partner for coordination, training and marketing
CREPA	Centre Regional pour l'eau potable et l'assainissement à faible coût, Ouagadougou and West African Region ; Aims to stop poverty by developing and implementing low cost technologies for drinking water supply, waste water treatment, and hygienic re-use; Partner for

	information and training; communication to CREPA members in neighbouring countries
CRA	Chambre Régionale de l'Agriculture de l'Est, Fada N'Gourma ; Organisation for support to agriculture and livestock sector; access to potential clients, biogas pilots, and group leaders for information and marketing.
CEAS	Centre Ecologique Albert Schweitzer, Ouagadougou and Centre-Est; ONG involved in food and agriculture processing and renewable energy; education, training and research & development, technical assistance at local level; potential partner for training of craftsmen, awareness raising, and for standardisation and quality control
EIER 2ie	Institut International d'Ingénierie de l'Eau et de l'Environnement, Ouagadougou Technical training, research and engineering education; provides services in terms of engineering expertise, studies, supervision and M&E;
RTB	Radio Television Burkina Faso

Table 46: Support Structure for Programme Chapter "Awareness raising & Marketing"

FIIMBA	Local Association, Bogande, Est region Social, ecological and economical development; partner for local campaigns and access to potential customers
APB	Local Association, Piela and Bilanga, Est region Social, ecological and economical development; partner for local campaigns and access to potential customers
APRET	Association pour la protection et la restauration de l'environnement ; Ouagadougou and Centre Est, Sahel Awareness raising campaigns for environmental concerns, health, reforestation, alphabetisation
AGED	Association pour la Gestion de l'Environnement et le Développement, Ouagadougou and Sahel ONG, working with German cooperation support on livestock and natural resource management in Sahel, Est and Centre regions
ASDC	Association Solidaire pour un Développement Communautaire, Meguet A ONG with international support such as DED, working with farmers for community development; access to potential biogas users; marketing & training
APFG,	Association pour la promotion de la Femme, Gaoua and Poni province, Sud-Ouest region; Micro/finance & micro business for women, Social and economic development; local partner for information and marketing
Te Biir Law	Local association in Diebougou, focussing on Dagara households Social and economic development programs; local partner for information and marketing
Union des	Breeder association in Dano, Ioba province, Sud-Ouest region; Introducing advanced animal husbandry techniques like zero grazing, compost pits,

eleveurs de Dano	and dairy systems; access to potential biogas farmers; local partner for information, marketing and demonstration

4.3.4 Training and private sector promotion

a) Private sector promotion

Support to private sector development will take a multi-dimensional approach and should be limited in time, i.e. a phase-out scenario should be elaborated right from the start on.

In the Renewable Energy Sector in general, although extended research work and promotion by international donor agencies has been carried out, the private sector was never really involved in the dissemination of new technologies. This is probably due to limits in technological knowledge and financial means encountering high capital costs required for start-up and promotional work.

An important and new field of private sector promotion lies the production of biogas equipment – lamps, burners and gas pressure measurement facilities – in Burkina Faso to supply the local market with low-cost high quality products. Technical skills once established in an enterprise will lead to job creation and sustainable development of local economy.

In communities where the NDBP will set up clusters for biogas dissemination, hardware stores could benefit from the program by deliverance of construction material and spare parts for biogas equipment.

Construction and piping work will be carried out by local enterprises and craftsmen only, thus enhancing not only employment and income, but also long term know how development and local economies.

b) Training of private sector

The NDBP would need to focus on technical and business training for private enterprises and/or interested craftsmen to start up their own biogas business. The participants in the training programs should receive all biogas and customer related information required for promotion, construction and after-sales services. It is obvious that a training program could not be limited to one session in the beginning of the NDBP, but will be an on-going training for updating and quality control.

NDBP should partner with national and local training and capacity building institutions to implement biogas technology as topic in the regular curricular.

c) Training of users

Questions like:

(i) How to keep the overflow point free from slurry? (ii) How to check the water trap from time to time, especially when there is no gas produced? (iii) How to clean the burner regularly like other cooking vessels? (iv) How to poke from time to time the inlet and outlet pipe, especially if substrate does not enter the plant? (v) How to change the mantle of the gas lamp, keeping it at a distance from food? (vi) What is the meaning of the slurry level in the expansion chamber? (vii) Where to ask for help in case of problems the household cannot solve alone?

should be considered in the training in which all users of biogas plants have to participate in. Knowledge transfer is a key element in the NDBP and at the same time essential for quality control, promotion and massive dissemination.

Training of users should take place in the villages where households have applied for biogas plants. It should be carried out in local languages in order to make sure that women could participate, understand and ask questions. If requested by the local community, the training for women should be separated from the one for men. But it is indispensable, that women receive a detailed training on operation and maintenance of the biogas plant and the gas appliances.

Thanks to a large number of local associations and groups, finding partners for user training might not be a problem for the NDBP. Already now the list of organizations which expressed their interest in cooperation is satisfactorily long; not all which have done this are currently included in the following tables.

Table 47: Potential NDBP partner for Programme Chapter "Training & private sector promotion"

DED	German social and technical service in development, Ouagadougou and countrywide Capacity building in local communities; very potential NDBP implementation partner for coordination, training, awareness raising, marketing strategy
ENEF	Ecole National des Eaux et Forets, Bobo-Dioulasso; international training hub for environmental administration staff
FAO	UN-Food and Agriculture Organization, office Ouagadougou
SNV	Netherland Volunteer Service, Ouagadougou and country wide; Social, ecological and economical consultancy to communities; very potential implementation partner for coordination, training and marketing
CREPA	Centre Regional pour l'eau potable et l'assainissement à faible coût, Ouagadougou and West African Region ; Aims to stop poverty by developing and implementing low cost technologies for drinking water supply, waste water treatment, and hygienic re-use; Partner for information and training; communication to CREPA members in neighbouring countries
CEAS	Centre Ecologique Albert Schweitzer, Ouagadougou and Centre-Est; ONG involved in food and agriculture processing and renewable energy; education, training and research & development, technical assistance at local level; potential partner for training of craftsmen, awareness raising, and for standardisation and quality control
EIER 2ie	Institut International d'Ingénierie de l'Eau et de l'Environnement, Ouagadougou Technical training, research and engineering education; provides services in terms of engineering expertise, studies, supervision and M&E;
WINROCK international	Office Ouagadougou: Training in business management and economics in the RE sector

Micro Sow, Hilec Et Co, Eveil du Faso	Private enterprises already engaged in the RE sector and interested in broadening their business competence
IRSAT	Institut de Recherches en Sciences Appliquées et Technologies, Ouagadougou As former Institut Burkinabé de l'Energie (IBE) installed several biogas plants throughout the country in the past ; R&D on renewable energy ; Partner for quality control, standardisation and training

Table 48: Support Structure for Programme Chapter "Training & private sector promotion"

FIIMBA	Local Association, Bogande, Est region Social, ecological and economical development; partner for on-site training and local business promotion
APB	Local Association, Piela and Bilanga, Est region partner for local training sessions and business development
APRET	Association pour la protection et la restauration de l'environnement ; Ouagadougou and Centre Est, Sahel ;
AGED	Association pour la Gestion de l'Environnement et le Développement, Ouagadougou and Sahel ;
ASDC	Association Solidaire pour un Développement Communautaire, Meguet : and business development in biogas
APFG,	Association pour la promotion de la Femme, Gaoua and Poni province, Sud-Ouest region;
Te Biir Law	Local association in Diebougou, focussing on Dagara households; partner for user training and micro business development
Union des eleveurs de Dano	Breeder association in Dano, Ioba province, Sud-Ouest region; Introducing advanced animal husbandry techniques like zero grazing, compost pits, and dairy systems; access to potential biogas farmers; Local partner for user training and business development

4.3.5 Standardization and Quality control

Standardization and quality control will be of utmost importance for the NDBP to achieve massive dissemination and long term sustainability.

Given a pre-defined customer target group, standards in plant volume will enhance affordability as costs for design will be reduced. The plant has anyhow to meet the customer's needs. Standards for gas appliances will match with after-sales-services to facilitate user's access to spare parts whenever and wherever needed. Standardization should also contribute to a long tern guarantee that the biogas plant will be convenient in operation and will deliver all possible benefits.

Training of masons, plumbers and constructors will focus on quality control related to standards and outputs of the whole biogas system.

The user should have access to equipment which performs according to national and international standards. To assure the availability of high quality products referring to the biogas plant, the related installations and gas appliances, NDBP will set up a catalogue of quality and standard criteria. Energy efficiency, affordability, user friendly access and handling, long lifetime and safety will be among the most important parameters local production and imported accessories have to comply with.

In Burkina Faso, research in the adaptation of technological appliances has always been strong, especially in the energy related sectors. NDBP can therefore rely on national partners, for example like IRSAT and the University of Ouagadougou.

A particularity will be, that a system of re-certification of enterprises will be installed that updates and check he performance of certified biogas constructors every second year.

Quality control will refer also to the biogas production and use of slurry as fertilizer. Biogas plant clients should be trained in using simple methods of control in order to monitor their installation closely and to benefit most from the investment.

Table 49: Potential NDBP partner for Programme Chapter "Standardization & Quality Control"

GTZ / GTZ-IS	German technical cooperation – worldwide expertise in biogas development and implementation
CREPA	Centre Regional pour l'eau potable et l'assainissement à faible coût, Ouagadougou and West African Region ; international relations for standardization
EIER 2ie	Institut International d'Ingénierie de l'Eau et de l'Environnement, Ouagadougou Technical training, research and engineering education; provides services in terms of engineering expertise, studies, supervision and M&E;
LNBTP	National Laboratory for Public Works and Buildings, Bobo-Dioulasso
IRSAT	Institut de Recherches en Sciences Appliquées et Technologies, Ouagadougou As former Institut Burkinabé de l'Energie (IBE) installed several biogas plants throughout the country in the past ; R&D on renewable energy ; Partner for quality control, standardisation and training

4.3.6 Impacts expected from NDBP

Impacts expected from NDBP are summarized in the following figure.

Figure 14: Causal Chain for NDBP Burkina Faso

Causal Chain for NDBP-BF

Input	Stakeholder participation, Expertise, Data, Information tools, Logistics, Funds				
Activities	Multi-sector dialogue				
	PMO & PCO	Financing	Marketing	Private Sector Promotion	Standardization & Quality control
	Policies & administration	Subsidy schemes & micro-credits	Awareness raising, information & publicity, marketing concepts	Training & follow-up, Business development, Applied research	Applied Research, rules & regulations, monitoring & evaluation
Output	Energy services by renewable biogas production for rural & peri-urban areas				
Outcomes	Enabling environment for biogas; agreements with international donors; example for region	Access to clean and affordable energy services for rural & peri-urban households, & SME	Increased awareness on energy, environment & health	Improved business skills & opportunities in biogas sector; boosting local economy	Safe & clean energy supply: local suppliers with low cost high quality products; user & customer friendly
Impact	* Poverty Reduction * Gender equity in access to sanitation, clean fuel, health & education * * Reduced deforestation & desertification * Improved agricultural yields & food security *				

5 Conclusions

The proposed program to promote the use of biogas in Burkina Faso could illustrate the positive impact that can be achieved through projects geared towards covering the basic energy needs of private households. The two main program construction components consist of

(1) Installing in medium term digestion tanks for animal dung and toilet waste for the generation of biogas for cooking and lighting in at least 14.000 private farmer homes, and

(2) Installing in medium term biogas septic tanks for household waste water, organic waste and toilet waste for the generation of biogas for cooking in at least 10.000 suburban households.

In total, up to 268.000 people could be supplied with this renewable energy in this manner in a relatively short period.

In long term the NDBP may extend its benefits to up to 90,267 rural households (conservative estimation), and up to 20,000 peri-urban households (conservative estimation). Small food processing units may also benefit in medium and long term from the program; it is estimated that up to 1,343 biogas installations will work at livestock markets, community slaughterhouses, fruit and vegetable transformation units and dairy facilities throughout the country.

If the NDBP will be managed well, dissemination figures of up to 180,534 rural households, 35,000 peri-urban households, and 2,102 food processors could probably achieved until the year 2030.

Table 50: Firewood and tree savings by one small rural household during 10 years of biogas plant operation

Year	Yearly fuel wood consumption of rural household Case 1[146] (kg)	Accumulation in fuel wood savings (kg)	Trees saved Accumulated in 10 years tree = 100 kg[147]
2008	7080	7080	70,8
2009	7080	14160	141,6
2010	7080	21240	212,4
2011	7080	28320	283,2
2012	7080	35400	354
2013	7080	42480	424,8
2014	7080	49560	495,6
2015	7080	56640	566,4
2016	7080	63720	637,2
2017	7080	70800	708

In rural areas women and children will no longer need to spend up to 5 hours per day gathering firewood, or in urban areas families will not any more spending large parts of their income for household energy. The sludge from the biogas plant will be used

[146] corresponds to 5.4 t fuelwood and 240 kg of charcoal

[147] WINROCK international, Cost/Benefit Analysis of national and regional Integrated Biogas and Sanitation Programs in Sub-Saharan Africa

together with composted agricultural residues as a valuable organic agricultural fertilizer or in the case of replacing septic tanks by biogas septic tanks the waste water effluent could be simply post-treated and reused for gardening. Moreover, water tight biogas digesters are feasible technologies that can treat wastes to recycle and minimize leaching out of pathogens and nitrogen to the environment. Excessive deforestation in the fragile ecosystem in the African Sahel will be reduced. Further advantages come from savings in fuel costs, better health conditions owing to the use of family toilets and generally improved sanitary conditions, the protection of natural resources, a reduction in CO_2 emissions and the transfer of technological skills.

The third component, oriented towards Small and Medium Enterprises (SMEs) in the field of agro-business, will reduce fossil energy costs for processing and storing. The organic waste produced can be recovered to improve the production surrounding and to deliver methane energy for heat and electricity production. A total of 2,000 SMEs are targeted by 2015.

Many small private companies could ensure high-quality construction, efficient operation and maintenance of the biogas plants. An estimated 1,200 jobs could be created. Families with a limited income would be able to afford the relatively high initial investment through micro finance schemes offered by the Network of the Burkina Faso Peoples Banks and NGOs. At the start up, it is proposed to subsidise up to 65% of the investment costs for the biogas plants, cooking and lighting equipment. However, the aim is for these subsidies to be progressively removed as the cost of the technology decreases. The program could be financed with the Burkina Faso government through FC funds provided by The Netherlands, Germany ad others.

In the first years some 100 initial plants will be installed and standardised. During this first 2-year phase, which aims to create an enabling environment for the implementation phase, all activities for capacity building and awareness raising will be started and carried out at all levels, and the marketing strategy clearly defined and developed. Other strategic elements like quality assurance, after sales service, institutional set up, involvement of Government and NGOs will be developed during the first two years.

The total number of biogas plants that can be installed by 2015 is estimated to be around 25,000. The program will promote a strategic long-term concept for clean domestic energy in Burkina Faso. The concept could be replicated in neighbouring countries, thus enabling regional dissemination and a regional exchange of experience. These included the countries of the Economic Community of West African States (ECOWAS) and of the Economic and Monetary Union of West Africa (UEMOA).

Key elements of such a program are:

- **The clients**:
    - Farmer households participating in agricultural development activities **and** livestock improvement programs
    - Urban and peri-urban households or housing developers forced to protect the environment and groundwater
    - Agro-processing industries and artisans on all scales and levels which needs thermal or electrical energy **and** produces organic waste and waste water
    - Municipalities which are responsible for municipal solid waste handling and/or public toilets

  - Institutions (rural, peri-urban and urban) which hosts a large number of persons and need thermal or electrical energy
- **The standards**
  - Technical and process designs appropriate for each client group **and** specific regional situation
  - Construction material **and** established and controlled design quality standards
  - Productivity rate parameters developed **and** used for evaluation (gas production per units of input material, power rate, sanitary sewage purification, waste handling, effluent handling, post treatment)
  - Biogas equipment industry standards developed **and** applied for stoves, lamps, pumps, stirrer, piping, generators etc.
- **The services**
  - management and promotion
  - quality control, monitoring and benefit evaluation
  - training and professional skill appraisal
  - funding and economic performance
  - socio-cultural and socio-technical research & development and standardization

Feasibility Study for a National Domestic Biogas Programme in Burkina Faso

Attachments 1 – 15

commissioned by

FINAL DRAFT
Published by:
Deutsche Gesellschaft für
Technische Zusammenarbeit (GTZ) GmbH

Name of sector project:
Partnerschaften und Netzwerke zur Förderung erneuerbarer und nachhaltiger Energie

Coordinated by:
Heinz-Peter Mang, Center for Energy and Environmental Protection (CEEP) / GTZ-CIM (Beijing)

Contributed by:
Elisabeth-Maria Huba (M.A.), World Toilet College (WTC/WTO) Singapore
Dr. Papa Abdoulaye Fall, GTZ-ecosan
Dr. Oumar Sanogo, Institut de Recherche en Sciences Appliquées et Technologies (IRSAT) Burkina Faso
Gombila Kaboré, Institut de Recherche en Sciences Appliquées et Technologies (IRSAT) Burkina Faso
Patrick Bracken, GTZ-Burkina Faso

Eschborn, July 2007

List of Attachments

Annex 1: Maps of Burkina Faso

Annex 2: Feasibility Study Mission program

Annex 3: History of Burkina Faso

Annex 4: List of biogas digesters build since 1979 in Burkina Faso

Annex 5a: TED biogas digester design sketch

Annex 5b: Biogas digester design Morocco

Annex 5c: Biogas digester design for sanitation

Annex 6a: Construction cost calculation for a 6m³ TED biogas digester design in Burkina Faso

Annex 6b: Basic household data from rapid Household Survey

Annex 6c: Current energy service costs for a rural 10-person household

Annex 7a: Economic calculations Case 1 (attached as original MS-Excel file)

Annex 7b: Economic calculations Case 2 (attached as original MS-Excel file)

Annex 7c: Economic calculations Case 3 (attached as original MS-Excel file)

Annex 8: Minutes of Stakeholder Meeting, April 27th, 2007

Annex 9: Institutions and enterprises with potential as NDBP-BF partners and supporters

Annex 10: Resource persons for the Feasibility Study Mission in Burkina Faso

Annex 11: Bibliography

Annex 12: Biogas potential in Burkina Faso – basic data sheets (attached as original MS-Excel file)

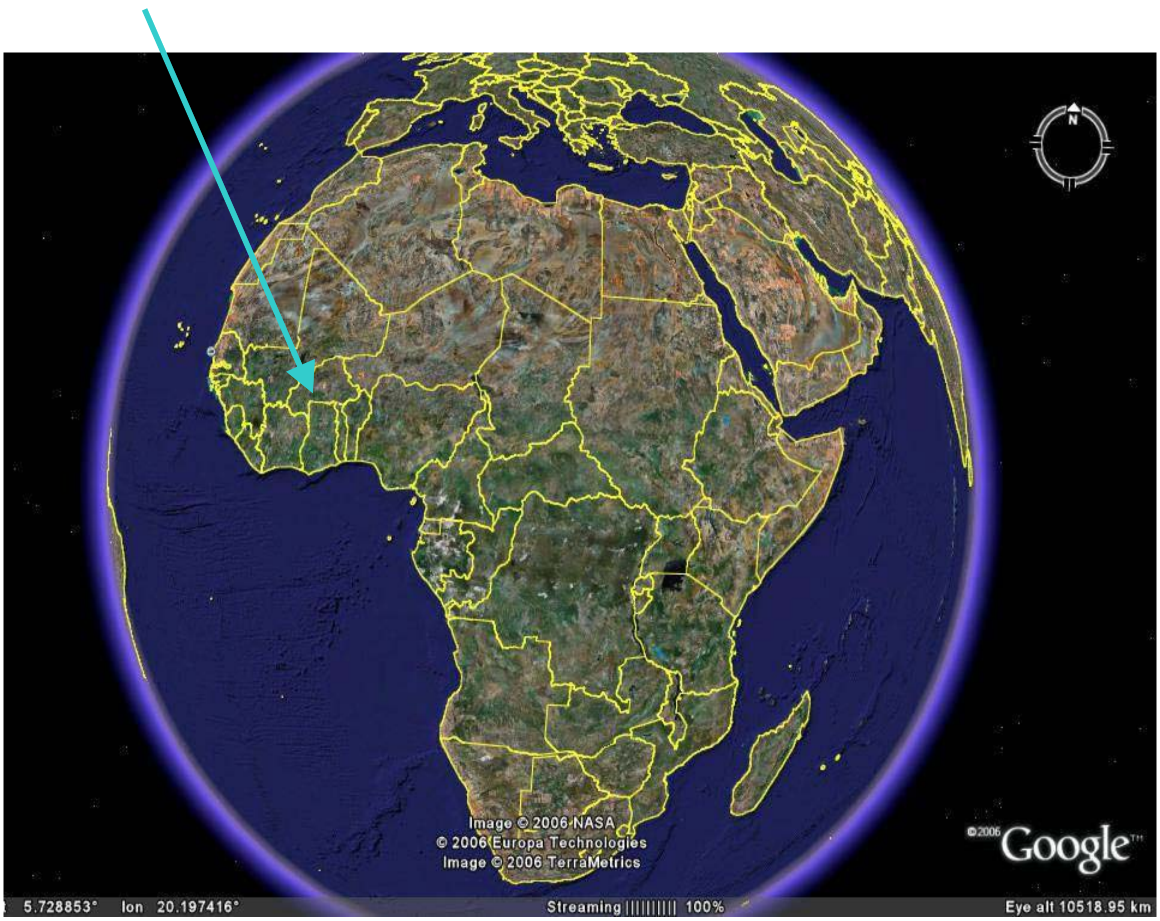
Annex 13: Terms of References

Annex 14: Questionnaire for Rapid Household Survey

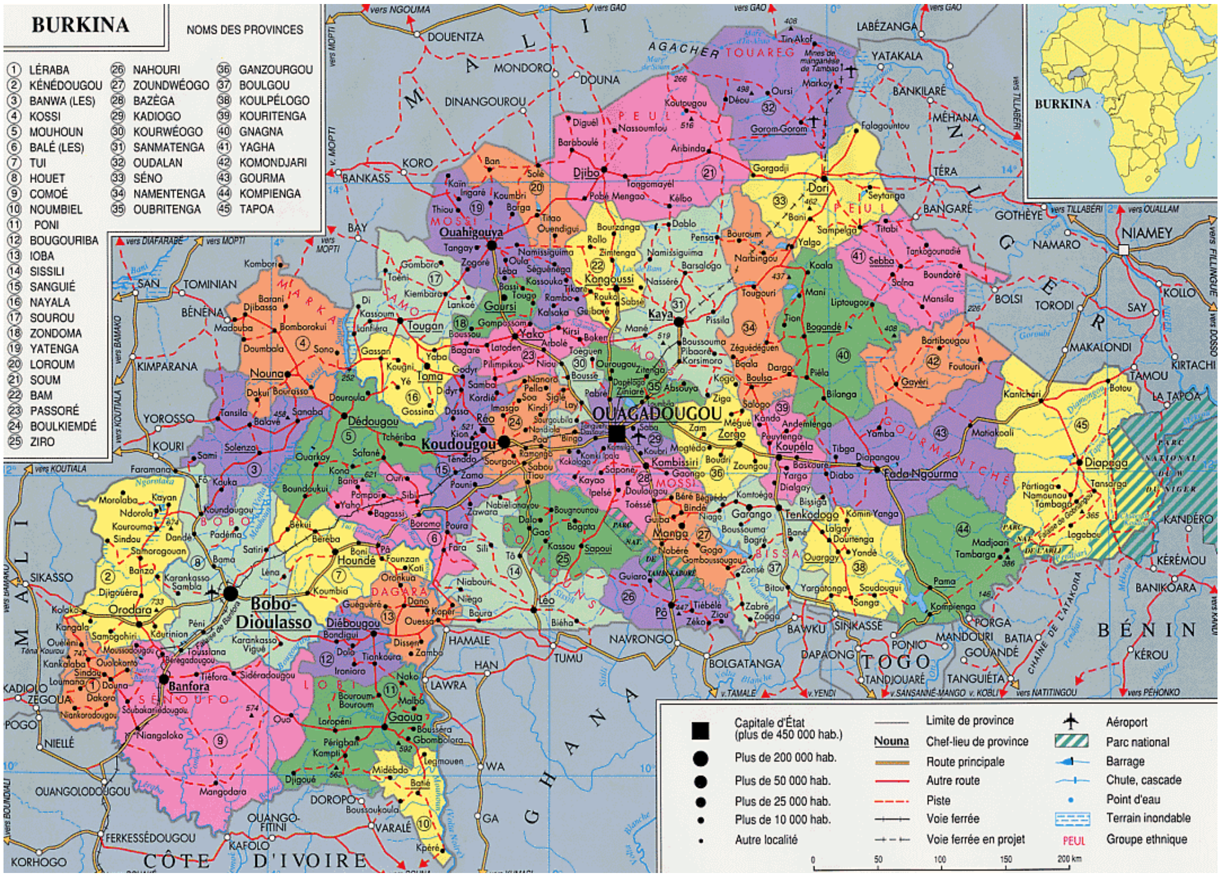
Annex 15: Photographs

Annex 1: Maps of Burkina Faso

Map 1: Burkina Faso in West Africa



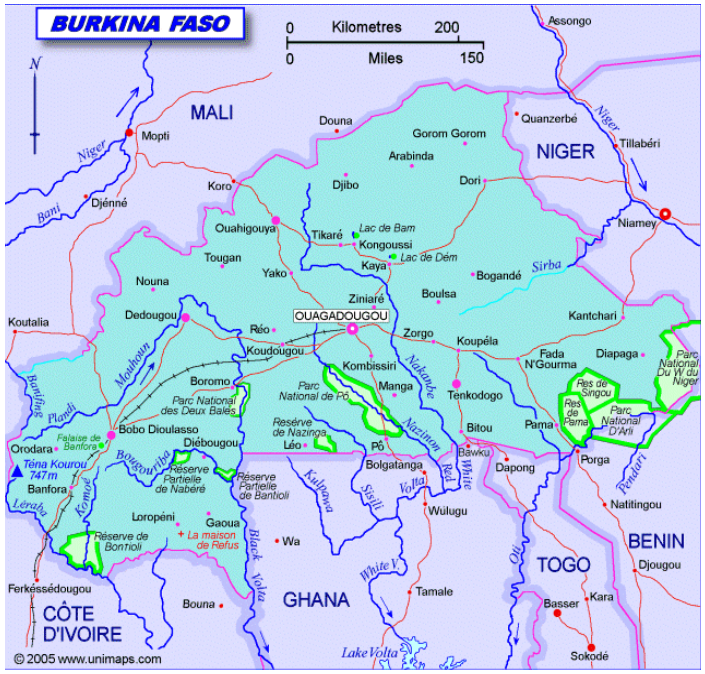
Map 2: Administrative structure – 45 provinces



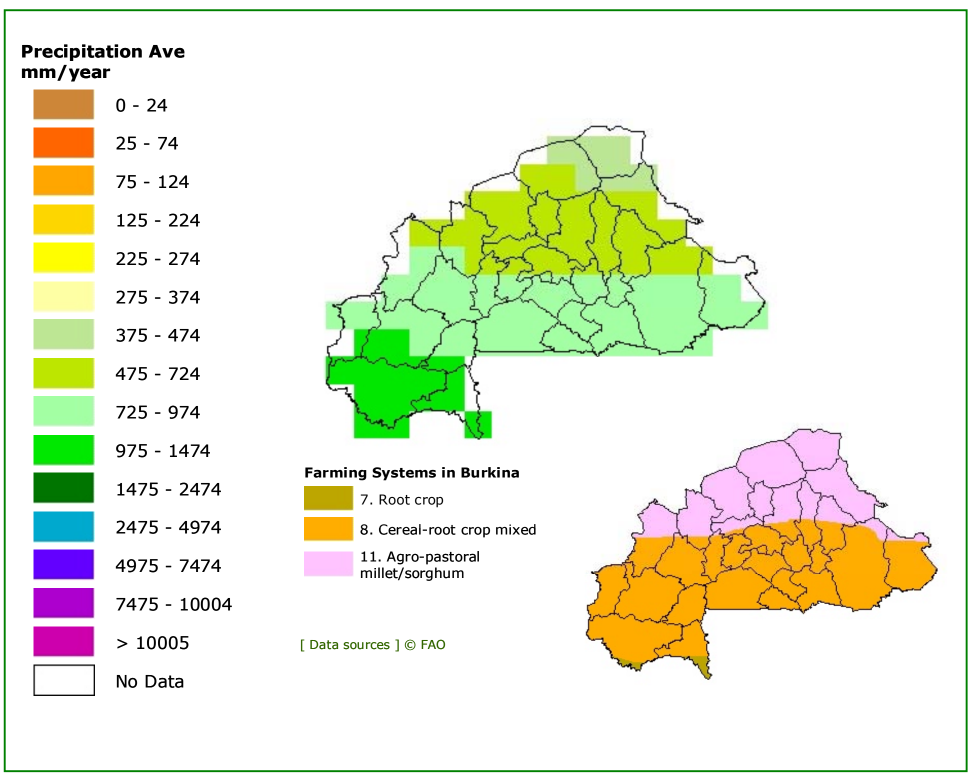
N° D'ORDRE	REGION	CHEF-LIEU	PROVINCES
1	BOUCLE DU MOUHOUN	Dédougou	BALE (LES) BANWA (LES) KOSSI MOUHOUN NAYALA SOUROU
2	CASCADES	Banfora	COMOE LERABA
3	CENTRE	Ouagadougou	KADIOGO
4	CENTRE-EST	Tenkodogo	BOULGOU KOULPELGO KOURITENGA
5	CENTRE-NORD	Kaya	BAM NAMENTENGA SANMATENGA
6	CENTRE-OUEST	Koudougou	BOULKIEMDE SANGUIE SISSILI ZIRO
7	CENTRE-SUD	Manga	BAZEGA NAHOURI ZOUNDWEOGO
8	EST	Fada-N'Gourma	GNAGNA GOURMA KOMONDJARI KOMPIENGA TAPOA
9	HAUTS-BASSINS	Bobo-Dioulasso	HOUET KENEDOUGOU TUY
10	NORD	Ouahigouya	LOROUM PASSORE YATENGA ZONDOMA
11	PLATEAU CENTRAL	Ziniaré	GANZOURGOU KOURWEOGO OUBRITENGA
12	SAHEL	Dori	OUDALAN SENO SOUM YAGHA
13	SUD-OUEST	Gaoua	BOUGOURIBA IOBA NOUMBIEL PONI

Map 3: Burkina Faso and neighboring countries

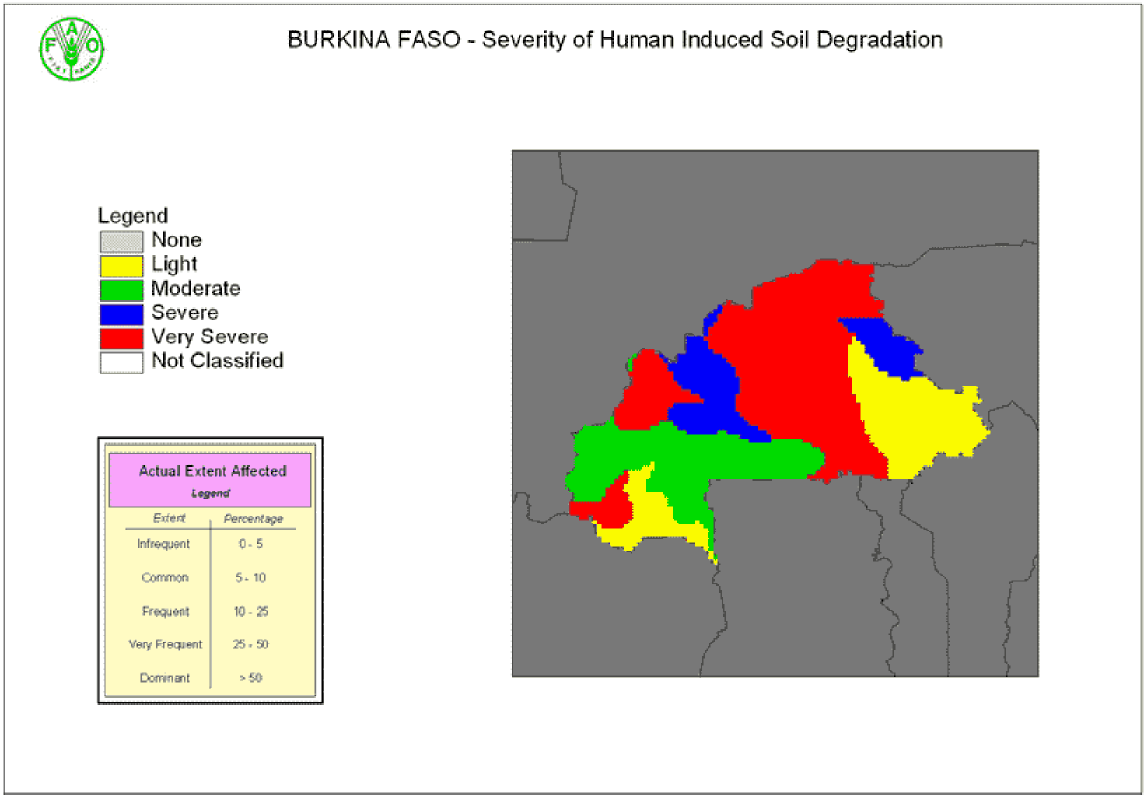
Map 4: Hydrological map of Burkina Faso



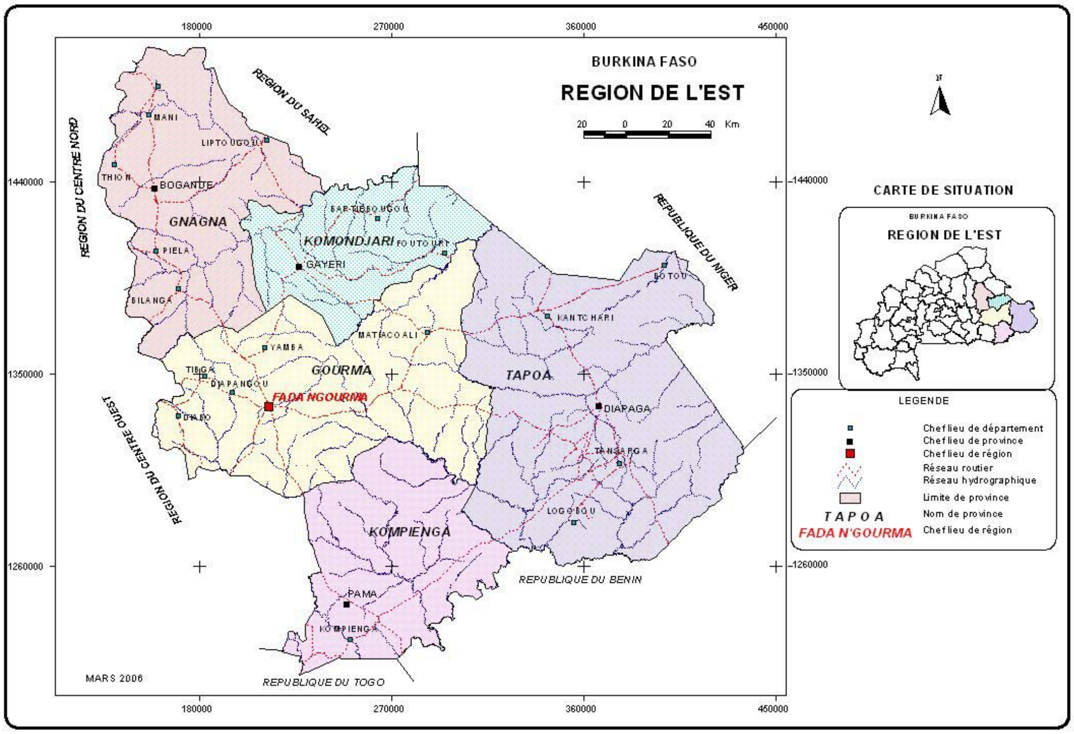
Map 5: Average precipitation and farming systems

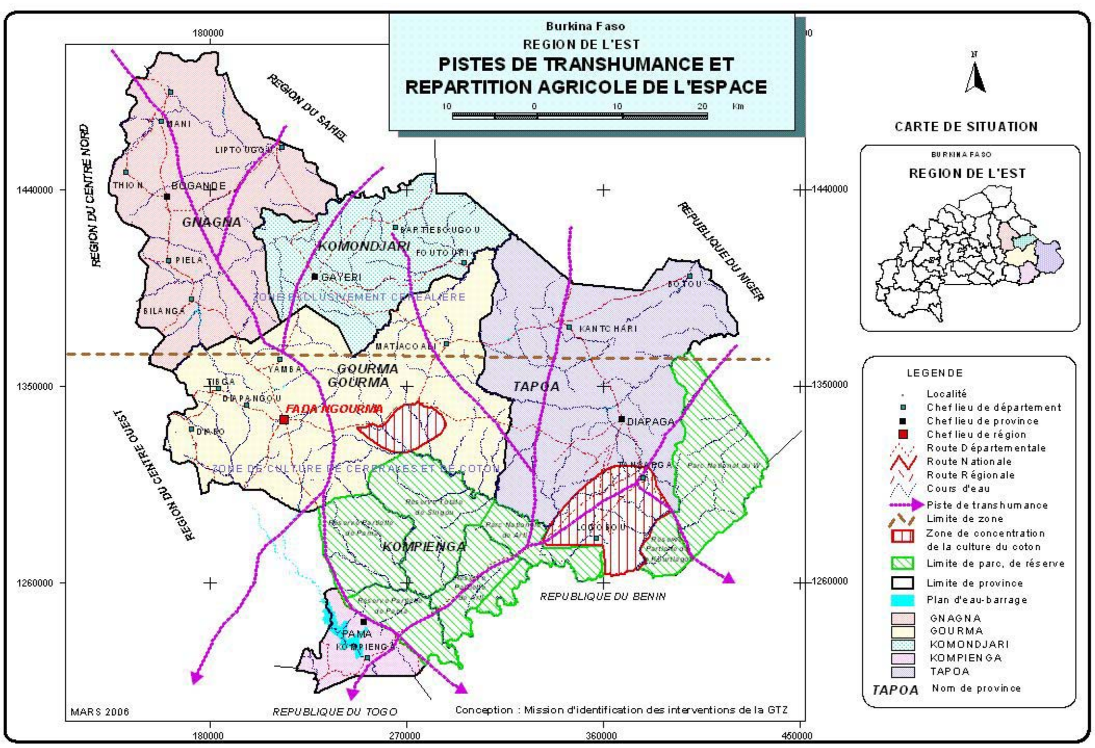


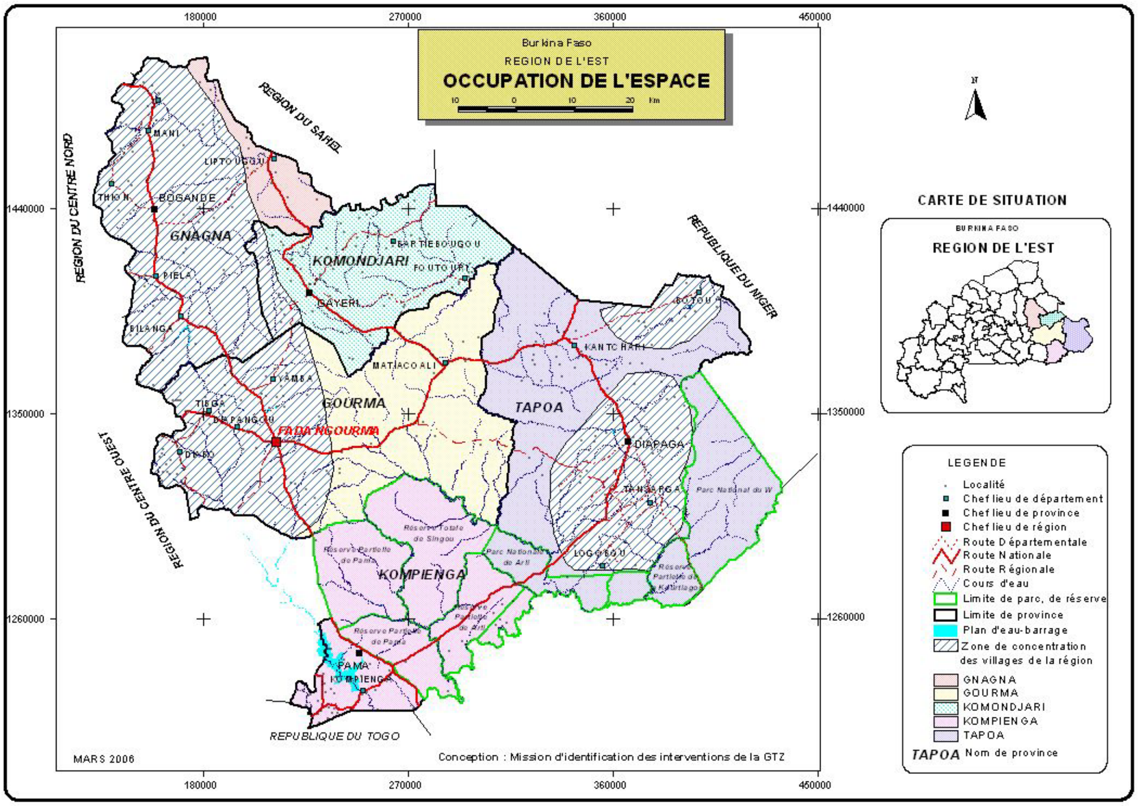
Map 6: Soil degradation



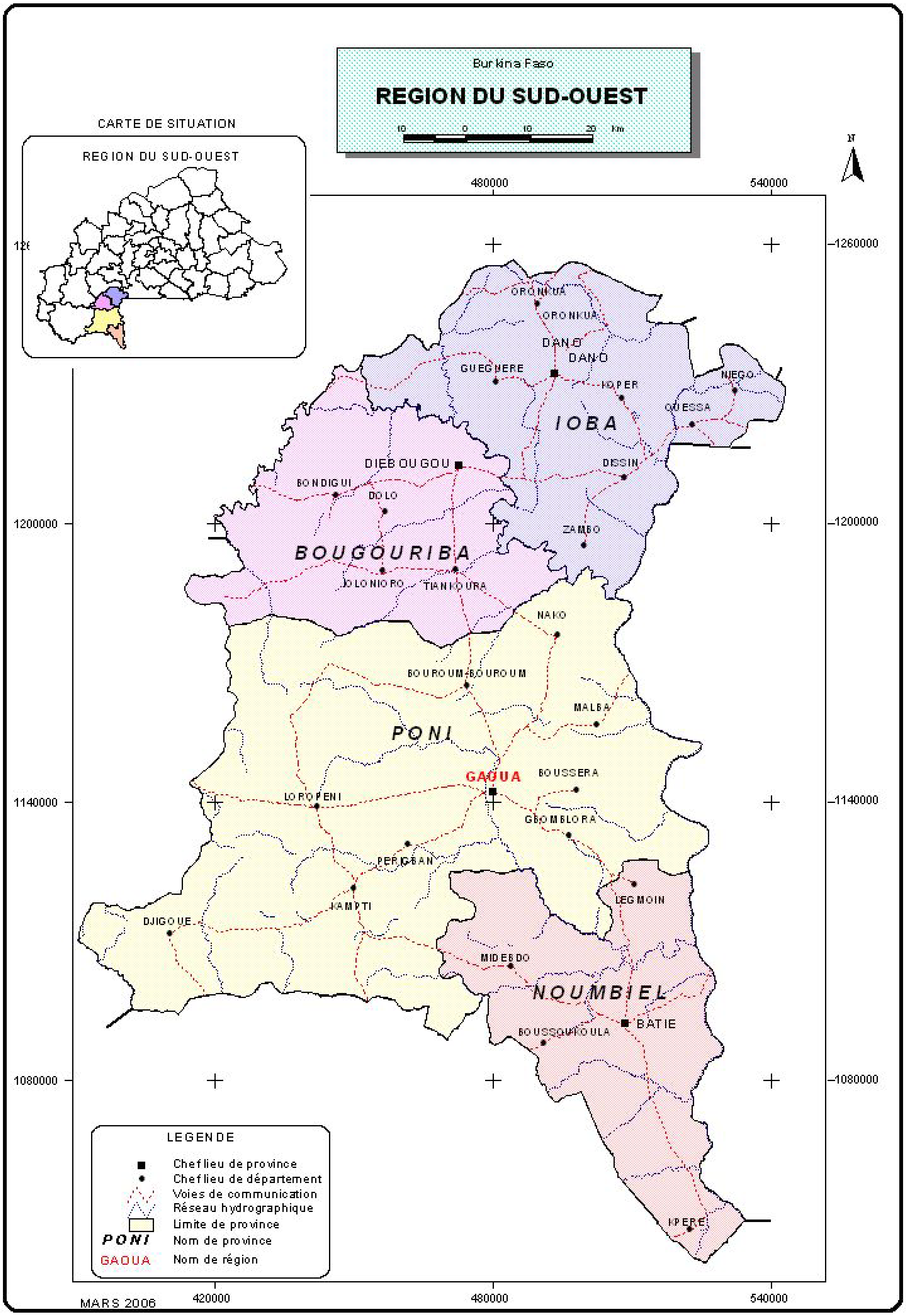
Map 7: Visited East Region

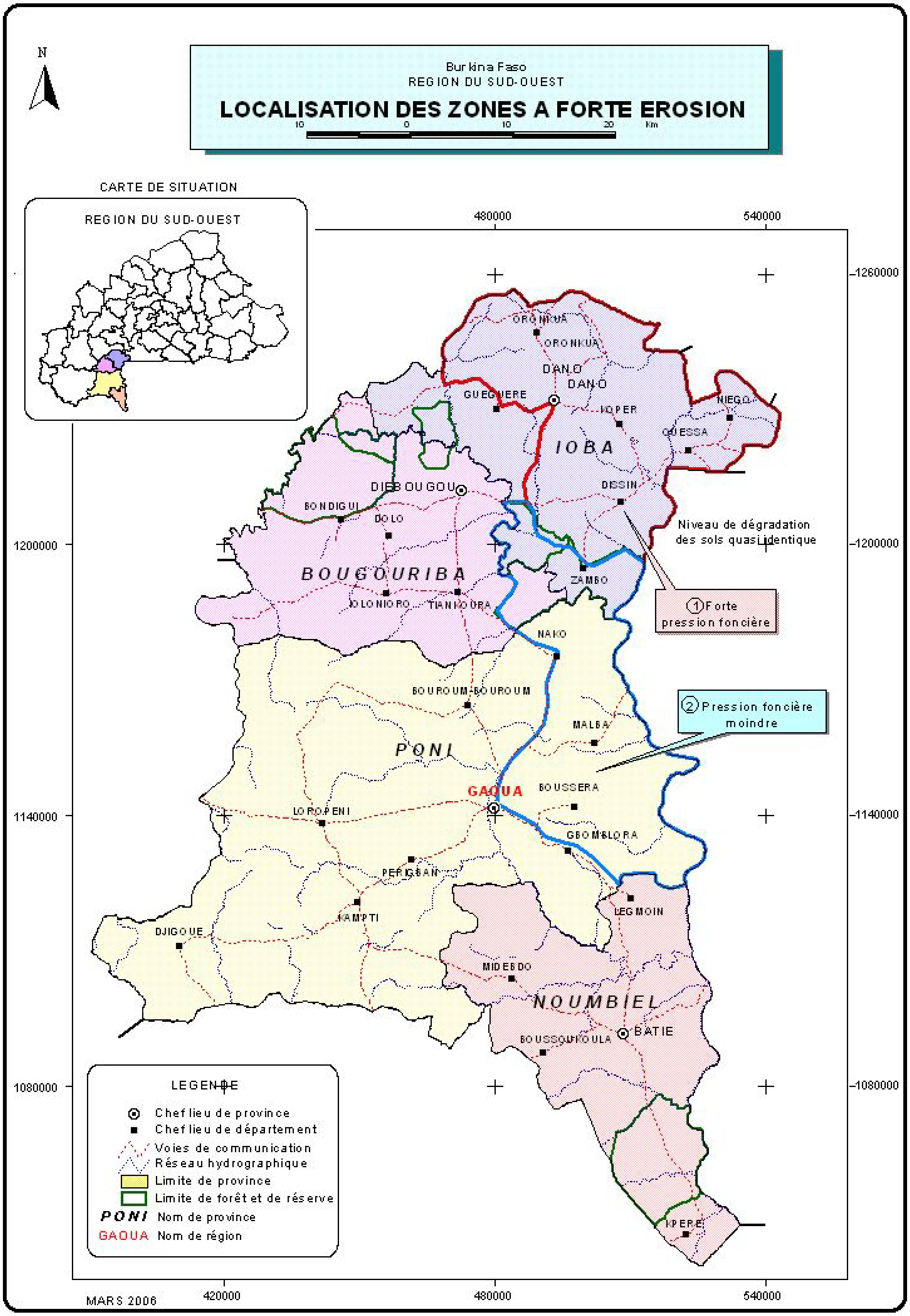


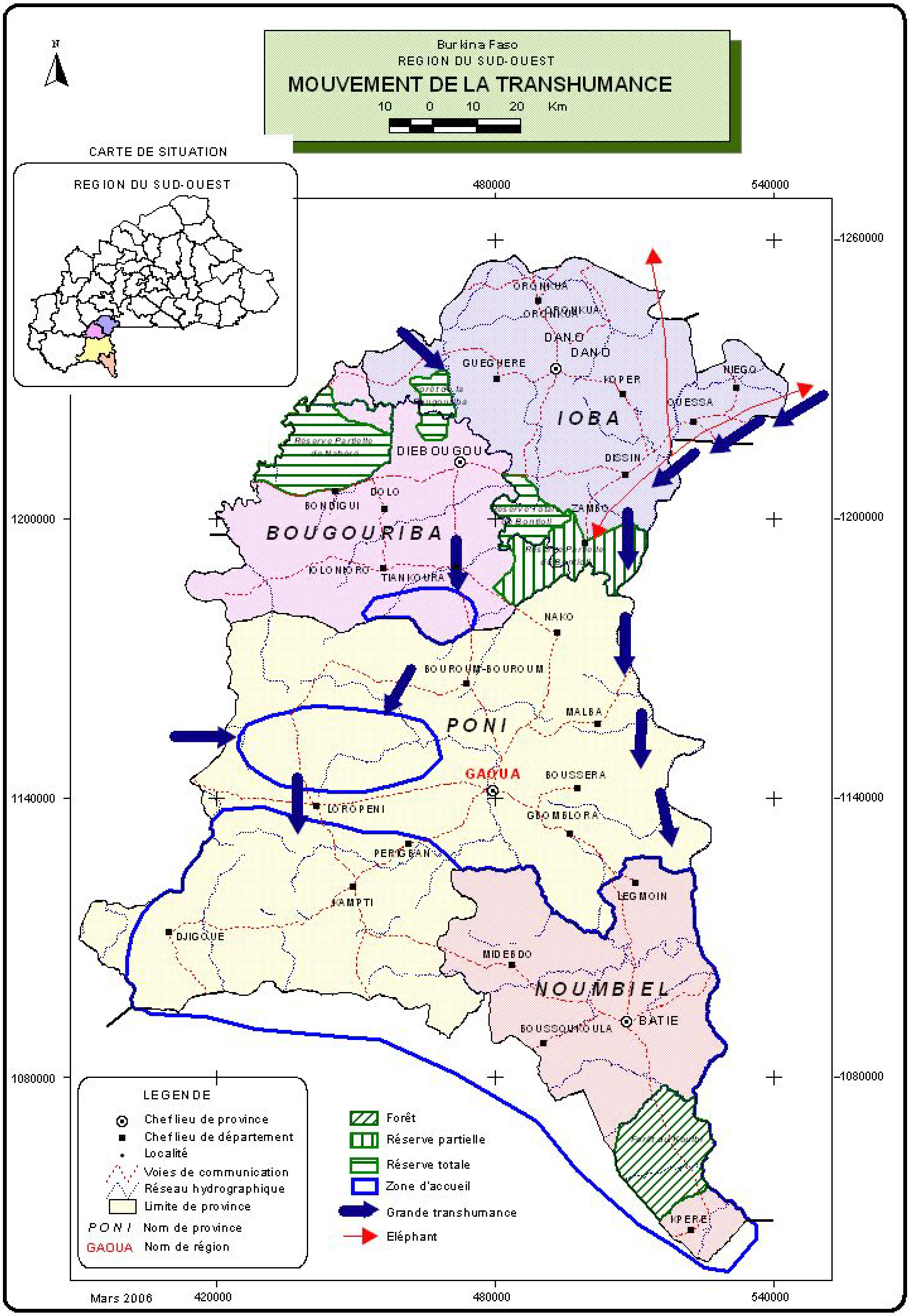



Burkina Faso
REGION DE L'EST
OCCUPATION DE L'ESPACE
CARTE DE SITUATION
BURKINA FASO
REGION DE L'EST
LEGENDE
Localité
Chef lieu de département
Chef lieu de province
Chef lieu de région
Route Départementale
Route Nationale
Route Régionale
Cours d'eau
Limite de parc, de réserve
Limite de province
Plan d'eau-barrage
Zone de concentration des villages de la région
GNAGNA
GOURMA
KOMONDJARI
KOMPIENGA
TAPOA
TAPOA Nom de province
REGION DU SAHEL
REGION DU CENTRE NORD
REGION DU CENTRE OUEST
REPUBLIQUE DU NIGER
REPUBLIQUE DU TOGO
GNAGNA
KOMONDJARI
GOURMA
TAPOA
KOMPIENGA
BOGANDE
FADA N'GOURMA
DIAPAGA
GAYERI
PAMA
MARS 2006
Conception : Mission d'identification des interventions de la GTZ

Map 8: Visited South West Region




Burkina Faso
REGION DU SUD-OUEST
LOCALISATION DES ZONES A FORTE EROSION
CARTE DE SITUATION
REGION DU SUD-OUEST
IOBA
BOUGOURIBA
PONI
NOUMBIEL
GAOUA
DIEBOUGOU
DANO
BATIE
ORONKUA
GUEGUERE
IOPER
NIEGO
OUESSA
DISSIN
ZAMBO
BONDIGUI
DOLO
TIANKOURA
NAKO
BOUROUM-BOUROUM
MALBA
BOUSSERA
LOROPENI
GBOMBLORA
PERIGBAN
KAMPTI
LEGMOIN
DJIGOUE
MIDEBDO
BOUSSOUKOULA
KPERE
Niveau de dégradation des sols quasi identique
1 Forte pression foncière
2 Pression foncière moindre
LEGENDE
Chef lieu de province
Chef lieu de département
Voies de communication
Réseau hydrographique
Limite de province
Limite de forêt et de réserve
PONI Nom de province
GAOUA Nom de région
MARS 2006


Burkina Faso
REGION DU SUD-OUEST
MOUVEMENT DE LA TRANSHUMANCE
10 0 10 20 Km
CARTE DE SITUATION
REGION DU SUD-OUEST
480000
540000
420000
1260000
1200000
1140000
1080000
IOBA
BOUGOURIBA
PONI
NOUMBIEL
GAOUA
DANO
DIEBOUGOU
BATIE
ORONKUA
GUEGUERE
KOPER
NIEGO
OUESSA
DISSIN
ZAMBO
DOLO
BONDIGUI
IOLONIORO
TIANKOURA
NAKO
BOUROUM-BOUROUM
MALBA
BOUSSERA
LOROPENI
GBOMBLORA
PERIGBAN
KAMPTI
DJIGOUE
LEGMOIN
MIDEBDO
BOUSSOUKOULA
KPERE
LEGENDE
Chef lieu de province
Chef lieu de département
Localité
Voies de communication
Réseau hydrographique
Limite de province
PONI Nom de province
GAOUA Nom de région
Forêt
Réserve partielle
Réserve totale
Zone d'accueil
Grande transhumance
Eléphant
Mars 2006

Annex 2: Mission programme

Mission Programme „Biogas for a better Life“ Burkina Faso

Day	Hour	Activities (Meetings, etc.)	Contact	Place
09.04.07	2.45	Arrival H.-P. Mang, E.-M. Huba,		Ouagadougou
	15.00 – 17.00	Briefing at GTZ-PDA office	Andrea Somé, Valerie Diallo	
	19.40	Arrival P.A. Fall, Airport		
	20.00 – 22.00	Meeting with Burkinabé Experts of IRSAT (Institut de Recherches en Sciences Appliquées et Technologies)	Oumar Sanogo, Gombila Kaboré	
10.04.07	9.15 – 10.00	Meeting with GTZ Office General Manager	Marina Mdaihli	
	10.00 – 11.15	Projet FAFASO Foyer Amelioré du Faso (Improved firewood saving stoves),	Mrs. Kaboré	
	11.15 – 12.00	Development Coordinator of German Embassy, and Vice-Coordinator of GTZ-PDA,	Anette Coly, Jules Somé	
	15.00 – 17.00	CREPA and Programme Eau et Assainissement	Simon Kenfack, Désirée Nana	
	17.30 – 18.30	Programme de Décentralisation et de Développement Communale (GTZ-PDDC)	Rémi Ouédraogo	
11.04.07	7.30 – 9.00	FICOD – German Financial Cooperation	Edzard Nebe, Abdoulaye Zongo	
	9.30 – 12.00	(1) Director of IRSAT (2) Ministry of Animal Ressources	(1) Alhadi Wereme (2) M. Rouamba	
	12.15 – 13.30	SOGEA – Municipal slaughterhouse management	Dr André Béré,	
	15.00 – 18.00	Petit Seminaire Pabré : biogas digester constructed in 1983 by GTZ	Abbey Gilbert Ouangrawa	
12.04.07	8.00 – 10.00	DED Burkina Faso Office	Suzanne Gentges, Gilbert Zomahoun	
	10.30 – 12.00	2iE: Institut International d'Ingénierie de l'Eau et de l'Environnement – Research and training institution	Dr. Joël Blin, Pr. Yézouma Coulibaly	
	15.00 – 17.30	(1) Direction Génerale des Energies Renouvelables et des Energies Traditionnelles	(1) Ouédragogo Bassirou	
	15.00 – 16.00	(2) Direction Génerale des Ressources en Eau – Direction de l'Assainissement	(2) Zounoubaté N'Zombié	
	16.30 – 17.30	CEAS: Centre Ecologique Albert Schweitzer - NGO in fruit processing and marketing	Pierre Guissou	
13.04.07	8.00 – 9.00	AGED: Association pour la Gestion de l'Environnement et le Développement - NGO working in livestock and agriculture together with GTZ-PDA	Alain Traoré, Boureima Zeza Drabo	

Day	Hour	Activities (Meetings, etc.)	Contact	Place
	9.15 – 10.15	CIFAME : Commission Intersectorielle de Facilitation de l'Approche Multisectorielle dans le domaine de l'Energie	Jean Paul Laude, Balla Moussa Ouattara	
13.04.07	10.30 – 11.30	APRET – Association working in environmental & rural development together with GTZ_PDA	Yacouba Traoré	Ouagadougou
	12.00 – 13.00	GTZ-IS	Klaus Gruetjen, Siaka Koné	
	15.00 – 17.00 16.00 – 18.00	(1) Ministère de l'Environnement et du Cadre de Vie / Direction de l'Assainissement et de la Prévention des Pollutions et des Nuisances (2) Private sector / enterprises engaged in renewable energy technologies	(1) Alain Edouard Traoré, Zéphirin Athanase Ouedraogo (2) Adjaka Kouami of HILEC & CO, Dayamba Frédéric, and Souleymane Sow of MicroSow	
	18.00 – 19.00	Action Stream International : international energy consultancy	Mme Nébié	
14.04.07	10.00 – 13.00	Expert group meeting for analysis	Mission Team	
	14.00 – 18.00	Individual work on report outline	Mission Team	
15.04.07	12.00 – 18.00	Travel to Fada N'Gourma: stops in 2 district centers to visit biogas plants constructed at health centers in 1985	Mission Team	Zorgho
	18.15 – 20.15	Training of Interviewers for Rapid Household Survey and basic understanding of biogas system	Djingri Nadieba, Yendie Lankoande, Idrissa Thiombiano, André Noula	Fada N'Gourma
16.04.07	8.00 – 8.45	GTZ – PDA office	Mission Team	
	9.00 – 9.30	Introduction visit to Haut-Commissaire	Kalil Bara	
	9.45 – 10.45	Direction Régionale de l'Environnement du Cadre de Vie	Sibiri Kaboré, Gustave Yaméogo, Jean Bosco Sow	
	11.00 – 12.00	(1) Direction Régionale de l'Agriculture (2) Start of Rapid Household Survey part Fada N'Gourma	(1) Idrissa Ilboudo	
	11.30 – 15.00	Travel to Bogandé for Rapid Household Survey part Bogandé	Part of Mission Team and interviewers	
	12.00 – 13.00	INERA	Dr. Oumar Ouedraogo and Dr. Sienou Adama	
	14.00 – 15.15	Chambre Régionale de l'Agriculture de l'Est – Meeting with Union Régionale des Groupements d'Eleveurs, Union des Eléveurs de porcs, Groupement des Producteurs de lait de vache	Sow Maquido, Louise Tandaba, Amado Dioni, J.P. Thiombiano, Ousmane Maïga, Nouhoun Dicko, Abdoul Karim Traoré	

Day	Hour	Activities (Meetings, etc.)	Contact	Place
16.04.07	15.15 – 16.15	Fédération des Agriculteurs	Mrs Christine Balima Lompo	
	16.30 – 17.30	Governor of East Region	Kilimité Hien	
	18.00 – 20.00	Feedback & questions from interviewers	Djingri Nadieba and Yendié Lankoande	
	15.00 – 15.45	Association FIIMBA	Guire Hassane	Bogande
	16.00 – 16.45	Mayor's office Bogande – General Secretary	Boro Assimi	
	17.00 – 18.00	Provincial Director for Environment	Jean Baptiste Nobila Nana, Souli Sibiri	
	18.00 – 18.45	Provincial Director for Animal Resources	Dioni Labdane	
17.04.07	6.00 – 20.00	Rapid Household Survey	Interviewer Team	Fada N'Gourma
	7.30 – 8.00	Ile de Paix – NGO focusing on capacity building	Gaël de Bellefroid	
	8.15 – 9.00	Caisse Populaire de Fada	Gilberte Béré	
	9.15 – 10.15	BACB	Salifou Sia	
	10.30 – 11.30	BIB	M. Nacanabo	
	11.45 – 14.30	ARFA: Association pour la Recherche et la Formation en Agro-écologie – Farm and Rural Training Center	Sawadogo Matthieu	
	15.00 – 18.30	Director of Rural Promotion Center	Pascal Bourgou	PK 60 (60 km from Fada N'Gourma)
	6.00 – 20.00	Rapid Household Survey	Interviewer Team	Bogandé
	7.30 – 8.30	Office of Haut-Commissaire	Rouamba Moussa Barthelemy	
	8.45 – 9.45	Provincial Director for Agriculture	Savadogo Somaila	
	9.45 – 10.45	PICOFA - Program to recover soil fertility by introducing compost plants	Kienou Macaire	
	11.00 – 12.00	FIIMBA – interview with accountant department	Tankoano Taladidia	
	14.00 – 16.00	Site visits and analysis of potential biogas related infrastructure: Slaughterhouse Bogandé, Dairy shop, vegetable market, hardware stores	Mission team	
	16.15 – 17.15	Hospital & provincial medical services	Dr. Belemvire Seydouh	
	20.00 – 21.00	feedback & questions from interviewers		
18.04.07	6.00 – 20.00	Rapid Household Survey	Interviewer Team	Fada N'Gourma
	7.15 – 8.00	Abattoir de Fada	Oumarou Tankoano, Salif Tandaba	
	8.15 – 9.00	Direction Régionale des Resources Animales	Drissa Salou Amado Nikiéma	
	9.15 – 10.00	PICOFA	Réné Yonli, Oula Ouattara, Moussa Toé	

Day	Hour	Activities (Meetings, etc.)	Contact	Place
18.04.07	10.15 – 11.30	Association Yemboado (Karité – Savon)	Mrs Lompo Christine	
	15.00 – 17.30	Visites de sites : Station (Ferme) Kikidemi Ferme Tanwal Mbougou Fermettes familiales	Amado Nikiéma	
	18.00 – 19.00	Plate forme multifonctionnelle		
	6.00 – 20.00	Rapid Household Survey	Interviewer Team	Bogandé
	8.00 – 10.00	Construction enterprises and material producers	Mission Team	
	10.15 – 11.00	Hospital – visit of "re-discovered biogas plant constructed in 1985 for Health Center	Dr. Belemvire Seydouh	
	11.00 – 17.00	APB – Association of Piela Bilanga – in cooperation with DED	Stefano Massone, Damolga B. David, Lankoande Simon, Seyi Foudou, and Charles Lankoande	Piela
19.04.07	6.00 – 12.00	Rapid Household Survey	Interviewer Team	Fada N'Gourma
	8.00 – 11.30	ASDC: Association Solidaire pour un Développement Communautaire – NGO working in cooperation with DED	Pierre Kaboré	Meguet
	11.30 – 15.00	Travel to Ouagadougou	Mission Team	
	15.30 – 16.30	FAO Consultant	Yacouba Samboré	Ouagadougou
	17.00 – 17.30	GERED – Etude et Recherche	Yameogo Gabriel	
	6.00 – 10.00	Rapid Household Survey	Interviewer Team	Bogandé
	10.00 – 12.00	Travel to Fada N'Gourma	Mission & Interviewer Team	
	11.00 – 11.30	Union Jeunesse Scolarisés Piela	Dianto Lanba	Piela
	12.00 – 13.00	Debriefing of RHS-teams in East region	Interviewer teams	Fada N'Gourma
	13.00 – 17.00	Travel to Ouagadougou	Mission Team	
20.04.07	08.30 – 09.30	(1) PAMER (2) Mairie Ouagadougou	(1) Guy Raoul Sanon and M. Hébié (2) Victorien Bonou	Ouagadougou
	10.00 – 11.00	Team Meeting: analytical discussion	Mission Team	
	11.00 – 16.00	Travel to Gaoua	Part of Mission Team	
	11.00 – 13.00	Union Economique et Monétaire Ouest Africaine (UEMOA)	Dianka Mamadou	Ouagadougou
	15.00 – 16.00	Institut Panafricain pour le Développement – Région Afrique de l'Ouest sahel (IPD/AOS)	Amadou Diop	
	16.30 – 17.30	GTZ –PROSAD	Eva Neuhaus	

Day	Hour	Activities (Meetings, etc.)	Contact	Place
	17.30 – 18.30	Direction de la Propreté / Mairie Ouaga	Mahamadou Cissé	
	16.00 – 16.30	Governor's Office	Ouangraouoa Rasmane	Gaoua
20.04.07	16.30 – 17.15	Regional Director for Animal Ressources	Prosper Ouedraogo	Gaoua
	17.30 – 18.30	Provincial Director for Environment	Sawadogo K. Sylvain	
21.04.06	8.30 – 9.15	Caisse Populaire de Gaoua	Somé T. Adolphe	
	9.30 – 12.00	Introduction and training of interviewer teams for RHS South West	Sie Kambiré, Sami Poda and team	
	12.00 – 17.00	Office Work	Mission Team	
		Market Survey: for Construction enterprises and material		
22.04.07	10.00 – 15.00	Office Work	Mission Team	Gaoua
	15.15 – 17.15	APFG – Women Association	Youl Yeri Viviane	
23.04.07	9.00 – 10.00	BACB	Séraphin Koalaga	Ouagadougou
	10.15 – 11.00	Direction Etudes et Planification / Ministère de la Santé	Landrim Boussary	
	11.15 – 13.30	Ecole Rurale AMPO	Samuel Ilboudo	
	15.30 – 16.30	MicroSow / Coopération suisse	Laurent Séchaud	
	17.00 – 18.00	Fédération des Caisses Populaires du Burkina	Daouda Sawadogo	
	08.00 – 20.00	Rapid Household Survey	Interviewer Team	Gaoua
	07.30 – 08.00	GTZ-PDA - Programme component soil fertility	Sawadogo Oumarou	Gaoua
	8.00 – 9.00	Travel to Diebougou	Part of Mission Team	
	9.00 – 9.30	GTZ-PDA	Alexandre Laenba	Diebougou
	9.30 – 10.30	Te Biir Law – Dagara Association for Improved Rural Livelihood	Somé B. Joel	
	10.45 – 11.45	ASUDEC – Africa's Sustainable Development Council, cooperation with HEIFER International	Ouattara Allamadoga	
	12.00 – 13.00	Varena Asso – NGO cooperating with DED	Balyao Somé	
	13.00 – 14.00	Travel to Dano	Part of Mission Team	
	15.00 – 17.30	(1) Provincial Director of Animal Resources & Union des Eleveur de Dano	Nikiema Etienne, Sawadogo Arouma, Diallo Mamadou	Dano
24.04.07	8.00 – 9.00	BAFP 96 - Bureau d'Appui en Santé Publique	Dr Joseph Catraye, Dr Kintin Frédéric	Ouagadougou
	9.30 – 10.30	Programme Eau et Assainissement / GTZ	Olivier Stoupy,	
	11.00 – 12.00	Banque Régionale de Solidarité	Tinbéni Lankoandé,	

Day	Hour	Activities (Meetings, etc.)	Contact	Place
	12.30 – 13.00	Direction du Suivi des ONG (DSONG)	Alassane Diallo	
	13.15 – 13.45	UICN	Mrs Diato	
	15.00 – 16.00	Groupement Eveil du Faso – Winrock International	Samuel Zongo, Salam Tassembedo	
	17.00 – 18.00	Chambre de Commerce, Industrie et Artisanat	M. Hébié	
	6.00 – 20.00	RHS Gaoua	Interviewer team	Gaoua
	8.00 – 11.00	Travel to Bobo-Dioulasso	Part of Mission Team	Dano
24.04.07	11.30 – 12.30	PABSO – Programme d'Aménagement des Bas-fonds au Sud Ouest	Hermann Schopferer, Jean Kis, Kassan Rubela, Hamidoue Seoue, Dembele Kassoum,	Bobo-Dioulasso
	15.00 – 16.30	SNV	Hans J. W. Meenink	
	16.45 – 17.30	Laboratoire National du Bâtiment et Travaux Publics	Kiemtore Serge	
25.04.07	8.00 – 9.00	FAO	Monika Tobler	Ouagadougou
	9.30 – 10.30	Direction de l'Hygiène Publique / Min. de la Santé	Yaya Ganou, Mrs Diane Somé-Compaoré	
	11.00 – 12.00	ONEA	Arba Jules Ouédraogo	
	12.30 – 16.00	(1) Centre de SARIA / INERA (2) Collège Enseignement Techn.	(1) Moussa Bonzi (2) Michel Kabré	Koudougou
	17.00 – 18.00	FAO	Mrs Marie Noel Koyara Ms Monika Tobler and Mr Bemba	Ouagadougou
	6.00 – 12.00	RHS ; debriefing	Interviewer team	Gaoua
	7.30 – 9.30	CFFA Farako-Bá – Centre de Formation Rurale	Bonde Mossi, Boni D. Jean Martin	Farako
	10.00 – 11.00	ENEF – Ecole Nationale des Eaux et Forets ; biogas installation build in 1980	Ouedraogo Joachim	Bobo-Dioulasso
	11.00 – 15.00	Travel to Boromo	Part of Mission Team	
	15.00 – 15.30	Boromo College – biogas installation build in 1985	Ousmane Faho, Gnienhoun Oscar	Boromo
	15.30 – 18.00	Travel to Ouagadougou	Part of Mission Team	
	18.30 – 21.00	Team debriefing session	Mission Team	Ouagadougou
26.04.07	8.00 – 20.00	Content preparation Stakeholder Workshop	Mission Team	Ouagadougou
	14.00 – 15.00	Dutch Embassy	Mrs Renet v. d. Waals	
	15.00 – 16.00	SNV Burkina	Jean-Marc Sika	
	16.30 – 18.00	Association Songtaab Yalgré	Mrs Marcéline Ouédraogo, Mrs Stéphanie, DED	

Day	Hour	Activities (Meetings, etc.)	Contact	Place
27.04.07	9.00 – 10.00	PNUD	Mrs Clarisse Coulibaly	
	8.00 – 13.00	Content preparation Stakeholder Workshop		
	13.30 – 14.00	Debriefing GTZ office and GTZ-PDA	Marina Mdaili, Florent-Dirk Thies	
	15.00 – 18.00	Stakeholder Workshop	See participant list in Annex Nr. 7	
	18.00 – 20.00	Individual and group talks		
28.04.07	8.00 – 10.00	Team Discussion	Mission Team	
	10.00 – 12.30	Travel to Ouahigouya	Mission Team	
	13.00 – 14.00	Slaughterhouse construction site	Souleymane Sow	Ouahigouya
	14.15 – 14.45	Ouahigouya College – projected construction site for biogas sanitation system by Belge cooperation	Goumbila Kaboré	
	14.45 – 16.00	Travel to Yako	Mission Team	
	16.00 – 16.30	Yako – hospital: biogas installation constructed in 1985	Gombila Kaboré	Yako
	16.30 – 18.30	Travel to Ouagadougou	Mission Team	
29.04.07	8.00 – 10.00	Team Discussion	Mission Team	Ouagadougou
	10.00 – 14.00	Market Survey completion	Mission Team	
	15.00 – 19.00	Team work on report	Mission Team	
	19.30 – 22.00	Team Debriefing	Mission Team	
30.04.07	01.00	Departure H.-P. Mang, E.-M. Huba		
	09.30 – 10.00	GTZ / PDA	Valerie Diallo	
	10.30 – 11.30	ISOMET sarl	William Ilboudo	
	12.00 – 13.00	GTZ / PDA	Mrs Rakiéta Poyga and Mrs Diallo	
	20.00	Departure P.A. Fall		

Annex 3: History of Burkina Faso

Burkina Faso was originally inhabited by the Bobo, Lobi, and Gurunsi people, with the Mossi and Gurma people immigrating to the region in the 14th century. The land of the Mossi empire became a French protectorate in 1897, and by 1903 France had subjugated the other ethnic groups. Called Upper Volta by the French, it became a separate colony in 1919, was partitioned among Niger, the Sudan, and Côte d'Ivoire in 1932, and was reconstituted in 1947. An autonomous republic within the French Community, Upper Volta became independent on August 5, 1960.

President Maurice Yameogo was deposed on Jan. 3, 1966, by a military coup led by Col. Sangoulé Lamizana, who dissolved the national assembly and suspended the constitution. Constitutional rule returned in 1978 with the election of an assembly and a presidential vote in June in which Gen. Lamizana won by a narrow margin over three other candidates.

On November 25, 1980, Colonel Sayé Zerbo led a bloodless coup that toppled Lamizana. In turn, Major Jean-Baptist Ouedraogo ousted Zerbo on Novovember 7, 1982. But the real revolutionary change occurred the following year when a 33-year-old flight commander, Thomas Sankara, took control. As Marxist-Leninist, he challenged the traditional Mossi chiefs, advocated women's liberation, and allied the country with North Korea, Libya, and Cuba. To sever ties to the colonial past, Sankara changed the name of the country in 1984 to Burkina Faso, which combines two of the nation's languages and means “the land of upright men.”

While Sankara's investments in schools, food production, and clinics brought some improvement in living standards, foreign investment declined, many businesses left the country, and unhappy labor unions began strikes. On October 15, 1987, formerly loyal soldiers assassinated Sankara. His best friend and ally Blaise Compaoré became president. Compaoré immediately set about “rectifying” Sankara's revolution. In 1991, he agreed to economic reforms proposed by the World Bank. A new constitution paved the way for elections in 1991, which Compaoré won easily, although opposition parties boycotted. In 1998, he was reelected by a landslide. A coup against the president was foiled in 2003, and he was reelected a third time in 2005.

Annex 4: List of biogas digesters build since 1979 in Burkina Faso

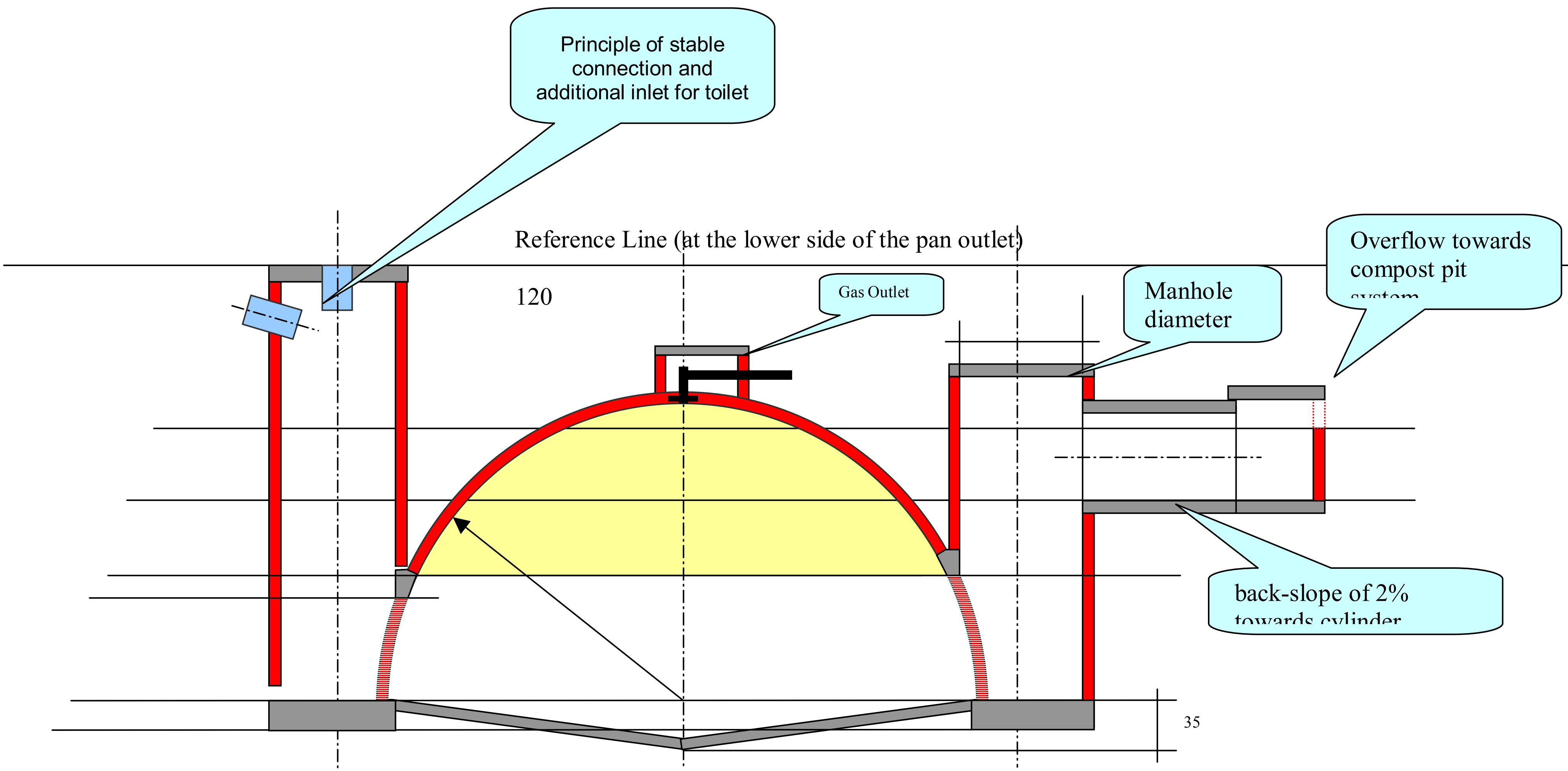
Established by IRSAT, 2007

Type of installation	Year of installation	Beneficiaries	Use	Observations
Borda with floating drum	2006	Training centre for young people in Balkuy (Ouagadougou)	School canteen	Being completed
Borda with floating drum	1998	Technical training centre in Kougoudou	School canteen	Functions irregularly due to a lack input material
Discontinuous with floating drum	1987	Koudougou military camp (Brigade d'Intervention Aéroportée)	Military canteen	Stopped in 1987
Discontinuous with floating drum	1987	Boromo provincial high school	Lighting classrooms	Stopped in 1994, access to a regular electricity supply from the national supplier Sonabel)
Discontinuous with floating drum		Trainer training centre for young farmers	School canteen	Stopped (lack of input material)
Discontinuous with floating drum		National Water and Forestry School	School canteen	Stopped (installed as part of the work required to finish training)
Discontinuous with floating drum		Experimentation Centre of the National School for Animal Health	Sterilisation of lab material	Stopped (attempt to construct digester with local materials)
Discontinuous with floating drum	1985	Tenkodogo Health Centre	Sterilisation	Stopped
Discontinuous with floating drum		Fada Health Centre	Sterilisation	Stopped
Discontinuous with floating drum		Yako Health Centre	Sterilisation	Stopped
Discontinuous with floating drum		Gaoua Health Centre	Sterilisation	Stopped
Discontinuous with floating drum		Banfora Health Centre	Sterilisation	Stopped
Discontinuous with floating drum	1983	Pabré Seminary	Teachers canteen	Stopped (lack of information)
Discontinuous with floating drum		Dédougou Health Centre	Sterilisation	Stopped
Discontinuous with floating drum		Training centre for agricultural trainers, Goundi	School canteen	Stopped
Discontinuous with floating drum	1982	Tondé family, Kongoussi	Irrigation	Stopped (end of test phase)
Discontinuous with floating drum		Management of the valleys of Kombissiri	Irrigation	Stopped (end of test phase)
Discontinuous with floating drum		Kaboré family, Nangbangré	Irrigation	Stopped (end of test phase)

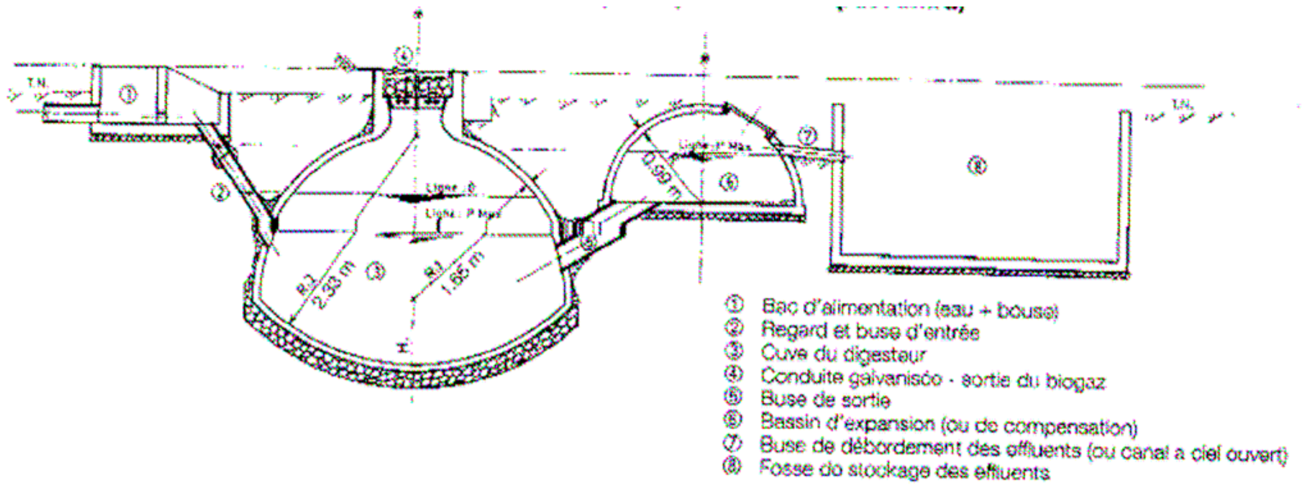
Type of installation	Year of installation	Beneficiaries	Use	Observations
Discontinuous with floating drum		Mogtédo Health Centre	Sterilisation	Stopped
Discontinuous with floating drum		Zorgho Health Centre	Sterilisation	Stopped
Discontinuous with floating drum		Experimental area, Saria	Irrigation and composting	Stopped (end of test phase)
Discontinuous with floating drum		Experimental area, Matourkou	Irrigation	Stopped (end of test phase)
Discontinuous with floating drum		Regional direction of the environment and rural equipment, Saponé	Conservation of pharmaceutical products	Stopped
Discontinuous with floating drum	1981	Monastery at Ziniaré	Lighting	Stopped
Discontinuous with floating drum		Training centre for young farmers	Canteen	Stopped
Discontinuous with floating drum	1979	Agricultural centre in Goundi	Canteen	Stopped
Discontinuous with floating drum		Training Centre on animal traction, Boulki	Household energy supply for cooking	Stopped

Annex 5 a: TED Lesotho Biogas digestor design

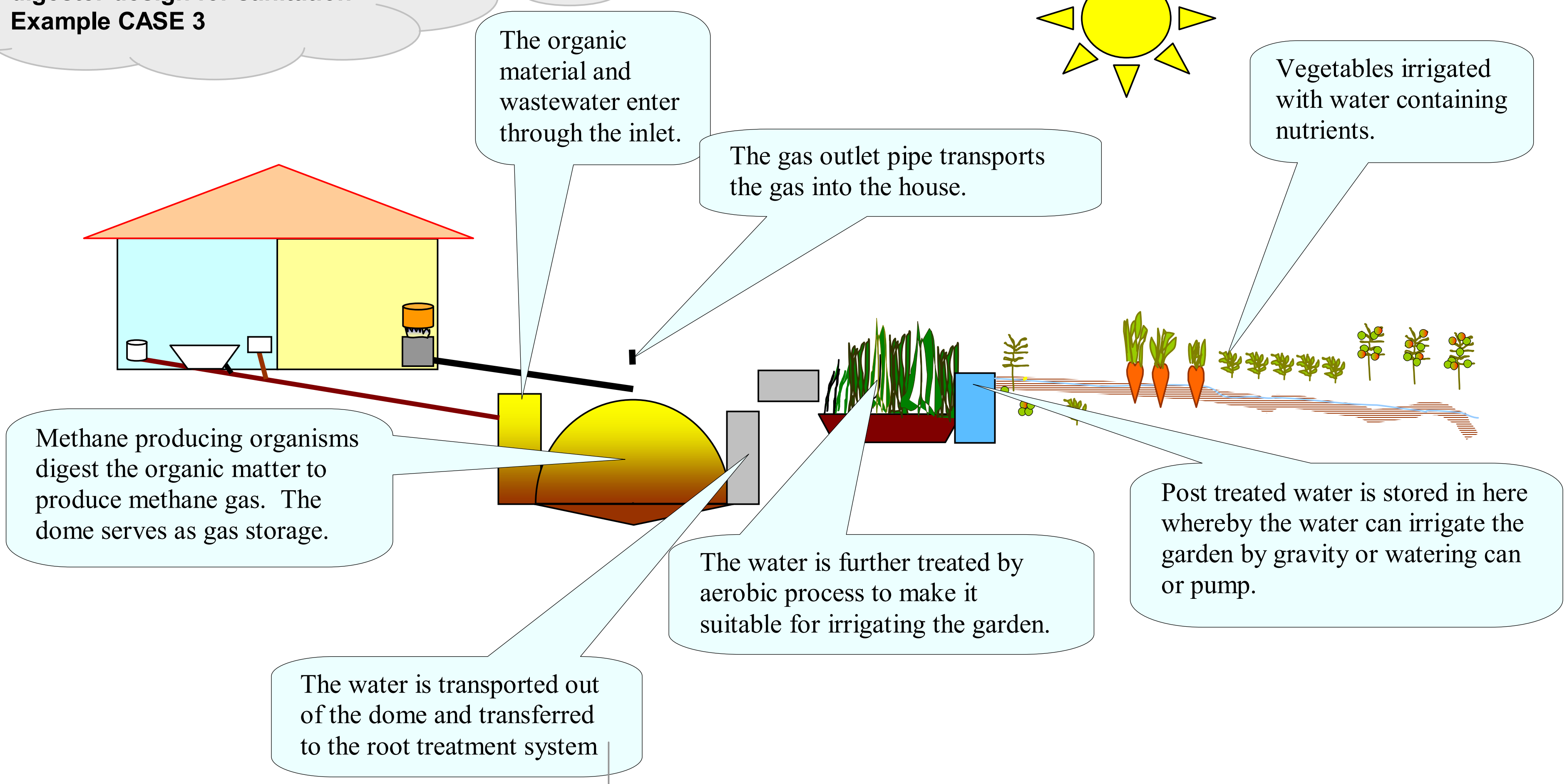
Fixed Dome Bio Septic Tank
Size: 6 m^3
Gas storage capacity: 1 m^3



Annex 5b: Biogas digester design for rural households in Morocco



Annex 5c: TED biogas digester design for sanitation Example CASE 3



Sketch of biodigester replacing a septic tank. Wastewater as well as kitchen and garden waste enter the digester and are broken down to biogas and fertile water.

The advantages: No more emptying of septic tank. Reuse of all water in the garden. Less cost on cooking energy.

Annex 6a: Construction cost calculation for a 6m^3 TED biogas digester design in Burkina Faso

Design parameters and construction cost calculation for a 6m^3 TED digester

DATA OF SUBSTRATE COMPOUNDS: cattle dung	
average live weight	300.00 kg/animal
feed load per day	15.00 kg/animal
total solids content	15.00 %
volatile solids content	13.85 %
specific gas yield [l/kg VS]	250.00 l/kg VS
at 30-33 °C a retention time of	25 days
number of units	2
human faeces	
average live weight	70.00 kg/person
feed load per day	1.00 kg/person
total solids content	20.00 %
volatile solids content	15.00 %
specific gas yield [l/kg VS]	300.00 l/kg VS
at 30-33 øC a retention time of	30 days
number of persons	7

SUBSTRATE MIX DATA	
feed load per day	37.00 kg/day
+ water/urine for dilution	
total solids content	8.80 %
volatile solids content	7.76 %
average digester temperature	26.00 °C
minimum retention time	120.00 days
digester volume	6.00 m3 net

BIOGAS APPLIANCES

burners:		lamps:	
power	1416.00 Watts	power	60.00 Watts
consumption/h	400.00 litres	consumption/h	145.28 litres
efficiency	0.60	efficiency	0.07
number of units	1	number of units	1
consumption period		consumption period	
,-,-,-,-,-,-,-,X,-,-,-,-XX,-,-,-,-,-XXX-,-,-,-,-		,-,-,-,-,-,-,-,-,-,-,-,-,-,-,-,-,-,-,-XXXX,-,-,-	
0 2 4 6 8 10 12 14 16 18 20 22 h		0 2 4 6 8 10 12 14 16 18 20 22 h	

GAS STORAGE DATA

gas production	1.56 m3/day	gasholder size	0.74 m3
gas consumption	1.49 m3/day	digester / gasholder ratio	8.09 : 1

PLANT SCALING AND STRUCTURAL DESIGN: fixed dome, spherical bottom shell

digester volume per plant	6.00 m3	height of hemisphere	1.34 m
gasholder volume per plant	0.74 m3	wall height of entry shaft	0.87 m
maximum gas pressure	0.95 m WC	radius of aperture of hemisphere	0.31 m
inner radius of hemisphere	1.38 m	Outer radius of entry shaft	0.58 m
radius of bottom shell	2.93 m	Lower slurry level	0.85 m
depth of bottom shell	0.34 m	upper slurry level	1.10 m
hight of foundation ring	0.13 m	angle of weak ring to central axis	51.83°
width of foundation ring	0.26 m	Weak ring width	0.03 m
wall thickness required	0.08 m	Weak ring height	0.03 m
wall thickness based on brick data	0.10 m		

1 displacement tank, type: spherical

radius of tank			0.71 m
wall height	0.80 m	wall thickness	0.10 m
height of overflow	0.70 m	Bottom slab	0.10 m
Material volume for masonry, concrete and plaster			
thickness of joints	1.00 m	inner surface (plaster)	18.10 m2
thickness interior plaster	1.00 m	outer surface (plaster)	22.71 m2
thickness exterior plaster	1.00 m	masonry for entry shaft	0.59 m3
inner plaster	0.18 m3	masonry for hemisphere	1.25 m3
outer plaster	0.23 m3	masonry for displ. tanks	0.38 m3
mortar for masonry	0.22 m3	concrete for foundation	0.75 m3
gas-tight plaster for gasholder part	0.06 m3	concrete for entry hatch	0.07 m3
gas-tight plaster for	5.57 m2	concrete f. bottom slab of displ. tanks	0.20 m3
		concrete total	1.03 m3
Brick and pipe data			
number of bricks required (without additions)	335.00	lime required (without additions)	30.77 kg
tensile strength	800.00 kN/m2	gravel required (without additions)	0.59 m3
length 0.40 m x width 0.15 m x height 0.10 m			
concrete required (without additions)	432.40 kg	sand required (without additions)	0.76 m3
inlet PVC pipe 4.00 inches; length: 1 x 1.94 m		outlet PVC pipe 6.00 inches; length: 1 x 1.12 m	
Construction pit data			
inflow level above outlet (overflow)	0.25 m	Bottom width of pit	0.00 m
reference line above outlet (overflow)	1.00 m	depth of construction pit	2.25 m
ground excavation	18.10 m3	upper radius of pit	1.69 m
angle of wall slope	85.00 ø	Bottom radius of pit	1.53 m
Output of building levels in relation to the reference level			
reference line	0.00 m	lower edge of foundation ring	-3.03 m
outlet level	-1.00 m	deepest point of bottom shell	-3.35 m
baseline of displacement tank	-1.70 m	aperture of the hemisphere	-1.56 m
excavation depth of displacement tank	-1.80 m	Lower edge of entry hatch	-0.89 m
hight of weakring and inlet pipe	-2.05 m	wall hight of entry shaft	-0.59 m
baseline of hemisphere	-2.90 m	level of inlet feed channel	-0.75 m

COST ESTIMATE

Item	*Units (pieces, kg)*	*FCFA / unit*	*Total FCFA*
brick	352 (351.75)	175.00 FCFA/1 units	61600.00
cement	10 (454.02)	5500.00 FCFA/50 kg-bag	55000.00
lime	2 (32.31)	7000.00 FCFA/20 kg	14000.00
gravel	1 (0.62)	35000.00 FCFA/6 m3	35000.00
sand	1 (0.80)	35000.00 FCFA/6 m3	35000.00
sealing compounds	6	1250.00 FCFA/1 m2	7500.00
SUB-TOTAL			**208100.00**
PVC pipe 4.0 inch	1	9255.00 FCFA/6 m	9255.00
PVC pipe 6.0 inch	1	27500.00 FCFA/6 m	27500.00
SUB-TOTAL			**36755.00**

COST OF PERSONNEL			
Personnel	*Number*	*days*	*FCFA*
mason	1	14	35000.00
Assistant	1	14	21000.00
designer	1	3	30000.00
SUB-TOTAL			**86000.00**

COSTS OF APPLIANCES			
Appliances	*Number*	*FCFA/unit*	*FCFA*
Burner	1	11000.00	11000.00
Lamp	1	45000.00	45000.00
SUB-TOTAL			**56000.00**

OTHER COSTS			
Item	*Number*	*Distance*	*FCFA*
Transportation of construction material: Wagon load	3	25	18750.00
Gas installation costs: gas pipes steel	Diameter inches: 0.75	Length (m): 60	28300.00
Fittings			12500.00
Timber			1500.00
Miscellaneous costs			2095.00
SUB-TOTAL			**63145.00**

Annex 6b: Basic household data example from Rapid Household Survey 2007

CASE 1	at least 7 persons + 2 cattle	
Nr.	*1*	*5*
code	*21*	*15*
economy	*medium*	*medium*
hh size	11	6
stabling system	2 permanent	2 permanent
agriculture ha	5	2,4
fertiliser	manure	manure
water	permanent	permanent
costs per year	6000	60000
firewood	permanent	permanent
charette/y	**12**	**6**
450 kg/charette	**5400**	**2700**
costs/y	9600	18000
km	5	1,5
hours	4	2
charcoal	no	yes
42 KG SAC	0	12
AMOUNT`	0	504
cost	0	18000
kerosene litre/y	**36**	**12**
cost/y	18000	6600
batteries pieces	72	0
cost/y	7200	0
cooking/d	3	2
hours/cooking	2,5	1
current toilet	no	no
biogas from animal manure & toilet for cooking & lighting	yes	yes
ability & willingness to co-finance improvements	>75000 FCFA	>50000 FCFA

CASE 2	at least 7 persons + 6 cattle	
Nr.	*13*	*20*
code	*10*	*13*
economy	*poor*	*don't know*
hh size	11	10
stabling system	6 overnight	7 permanent
agriculture ha	7	6,25
fertiliser	compost & manure & chem: 25000 FCFA	manure
water	perm	not perm
costs per year	18000	0
firewood	perm	perm
charette/y	**6**	**36**
450 kg/charette	**2700**	**16200**
costs/y	0	15600
km	2	0
hours	4	0
charcoal	no	yes
42 KG SAC	0	12
AMOUNT`	0	504
cost	0	21000
kerosene litre/y	**24**	**0**
cost/y	nd	0
batteries pieces.	48	0
cost/y	4800	0
Electricity cost/y		**72000**
cooking/d	2	2
Hours/cooking	2	2
Current toilet	no	yes
biogas from animal manure & toilet for cooking & lighting	yes	yes
ability & willingness to co-finance improvements	>3000 FCFA	nd

CASE 3	At least 10 persons + 12 cattle	
Nr.	*14*	*16*
code	*3*	*12*
economy	*poor*	*poor*
hh size	16	23
stabling system	12 permanent	12 overnight
agriculture ha	15	5,5
fertiliser	compost & manure & chemical 100000 FCFA7year	12500 FCFA/y
water	permanent	permanent
costs per year	18000	12000
firewood	permanent	not permanent
charette/y	**12**	**12**
450 kg/charette	**5400**	**5400**
costs/y	0	0
km	5	7
hours	3	7
charcoal	no	no
42 KG SAC	0	0
AMOUNT`	0	0
cost	0	0
kerosene litre/y	**24**	**24**
cost/y	12000	15120
batteries pieces.	0	48
cost/y	0	4800
cooking/d	2	2
Hours/cooking	2	2
toilet	no	no
biogas from animal manure & toilet for cooking & lighting	yes	yes
ability & willingness to co-finance improvements	200000 FCFA	yes

Annex 6c: Energy services required by a rural 10 person household under current conditions in Burkina Faso

Fuel wood amount	**5400**	kg/year
Fuel wood costs	**6**	FCFA/kg
Charcoal amount	**240**	kg/year
Charcoal costs	**43**	FCFA/kg
Kerosene amount	**36**	ltr./year
Kersone costs	**630**	FCFA/ltr.

Average amount on household energy/year and energy prices for a rural family with 10 persons

Type of source	**Input**	**Conversion efficiencies**	**output**	**Unit**
Energy service from fuel wood used for cooking	24,300.00	6.0 %	1458.00	kWh/y
Energy service from charcoal used for cooking	1,680.00	22.0 %	369.60	kWh/y
Total cooking			1827.60	
Biogas for cooking	3,384.44	54.0 %	1827.60	
Lighting service energy	360.00	0.3 %	1.08	kWh/y
Biogas for lighting	63.53	1.7 %	1.08	kWh/y

Final energy service provided by the household fuel and compared to biogas to get the same energy service output

Source	**TLU Tropical livestock unit (=250 kg animal live weight)**	**Annual biogas potential m3/TLU if zero-grazing**
Donkey	0.4	292
Cattle	0.9	237
Camel	1	292
Goat	0.12	328
Sheep	0.12	328
Horse	1	292
Porc	0.33	273
Poultry	0.01	365
Person	Using toilet connected to biogas plant	7 cbm/year

Biogas energy potential of different sources in Burkina Faso (about 70% of the individual emission potential)

Annex 8 : Minutes of Stakeholder Meeting

Protocol « Atelier de Restitution », Ouagadougou 27-04-2007

Volet I – Finance & Micro-Crédit

- Commentaire:
  - Tenir compte de la viabilité du mécanisme de Financement
  - Tenir compte du niveau de pauvreté en milieu rural de la fixation des taux de subventionnement en équipement
  - S'assurer dès le départ de la renta financière des équipes au niveau des entreprises
  - S'assurer de la viabilité de l'énergie biogaz (sub-attestation possibles
  - Pertinence du choix de vulgarisation du biogaz

- Acteurs:
  - Banques & Institutions de Micro-Finance :
    - BRS/BF : Ouaga 01 BP 1305 / 50496000 / -05, Mr. DG Kone Karim
    - RCPB
    - BACB
    - Rôle :
      - Octroi de crédits
      - Création des subventions
      - Partenariat avec les autres acteurs / Partage d'infos : formation, suivi & contrôle de qualité
  - Structures d'appui :
    - PAMER : Ouaga 09, BP 751 / pamer@fasonet.bf
    - MEBF
    - UEMOA
    - FICOD
    - Rôle :
      - Accompagnement et facilitations des crédits & subventions
      - Promotion des entreprises
  - Structures des contrôles :
    - Cellule technique Microfinance / Trésor

- Participation au Comité de Direction:
  - BRS
  - RCPB

Volet II – Sensibilisation & Publicité

- Commentaire:
  - Radios communales
  - Séances de projection
  - Théâtre, forum
  - Journaux
  - Affichages
  - Sensibiliser un noyau pour continuer le travail de sensibilisation
  - Cibler les OP
    - Cibler des exemples réeles
  - Grandes manifestations p.e. FESPACO
  - Visites échanges sur les unités testes

- Institutions & personnes de contact
  - Les collectivités territoriales, régions et communes : Pd Conseils Régionaux et Maires
  - DSTM : Représentante AMBF
  - Direction de propreté : Représentante AMBF
  - CRA : Secrétaire Généraux
  - Direction de la Promotion féminine : Directrice régionales
  - Société civile / Associations : Union des éleveurs du Gourma – Mr. Sow Matiodou - 70274456
  - Ded : dedbfa@ded.de
  - Crepa : direction technique – Mr. Cheick Tandia - +226 50366210
  - Cresa : direction pédagogique & science communication
  - FAO : Monika Tobler / Maria Noel Koyara – 50306057 / -58 monika.tobler@fao.org
  - EIER 2ie – direction générale
  - Services déconcentrés de l'état : dr de l'environnement
  - RTB & autres media : direction radio rurale

- Participation au Comité de Direction – commentaires :
  - Les collectivités … : Point focal communes
  - CRA : Création d'un bulletin
  - Société civile / Associations : point focal de société civile
  - EIER 2ie – point focal par institutions

- Questions ????
  - Pourquoi le transfert du savoir sera-t-il possible cette fois-ci ?
  - Comment assurer la transmission du savoir/ maintien ?
  - Stratégie de communication
  - Mécanisme de financement
  - Création d'une association pour la sensibilisation biogaz ?
  - Place du suivi / contrôle ?

Volet III – Formation & Entrepreneuriat

- Commentaire:
  - Allége ou revoir a la simplification du cadre institutionnel du projet
  - Etudier d'avantage la réceptivité du milieu par rapport a l'innovation de cet envergure
  - Implication du milieu urbain dans le processus
  - Implication des architectes dans le milieu urbain pour faciliter le contrôle de qualité

- Institutions & personnes de contact
  - Formation AMPTO / TT 50 370276
  - INADES
  - Université
  - CNRST – IRSAT
  - CIRAD
  - Centre de Formation de la Municipalité
  - INERA : Mr. Boly
  - WINROCK International : Patrice Beaujault – pbeaujault@winrock.org
  - CREPA : IL Tandian - +226 50366210
  - CEAS :Mr. Guissou – 50343927 / 70214005 / guissou@gmail.com
  - IPD / AOS: Mr. Diop Amadou – 50364762 / 50364807 / fax: 50364730 / www.ipdaos.bf / ipd_aos@cenatrin.bf
  - 2iE: Mr. Paul Gines – 50307116 / -17 / fax: 50336091

- FAO: Monika Tobler – 50306057 /-58 / monika.tobler@fao.org / Marie Noel Koyara

- Entreprises à intégré dans le volet de formation
  - MicroSow : Mr. Souleymane Sow – info@microsow.com / 70206297
  - CEAS
  - Hilec Et Co: Mr. Adjaka Kouami – hilecetco@fasonet.bf / 78813647 / 50358292
  - Eveil du Faso: Mr. Zango Samuel - eveildufaso@yahoo.fr / 70705610
  - INTELFAC : Mr. Barry Proper – 70204035
  - GGY : Yameogo Gabriel

- Participation au Comité de Direction – commentaires :
  - Le CD doit être compose de membres permanents et non permanents
  - Membres permanents :
    - 2 organes de presse
    - 2 organes de formation
    - 2 organes d'entreprises
    - 2 organes banques
    - 2 organes ministères

Volet IV – Standardisation & Contrôle de Qualité

- Génie Civil :
  - Standardisation des cotes
  - Qualités des sols
  - Standardisation des tailles
  - Qualité des materiaux

- Qualité des matières :
  - Intrants dans les digesteurs
  - Gaz produits
  - effluents

- Acteurs :
  - IRSAT – Ouaga 03 BP 7047 / +226 50357029 / dirsat@fasonet.bf / Mr. Alhadi Ivereme
  - CREPA – Ouaga 03 BP 7112 / n+226 50366210 / Mr. Cheick Tandia
  - SONGTAABA – BP 6696 / +226 50341974 / Mme Ouedraogo Marceline
  - LNSP
  - UFR / SVT / UO
  - BUMIGEB
  - LNBTP

Liste des participants
Date: Vendredi 27 Avril 2007 à partir de 15h, Salle de Réunion de l'ABMAQ
Objet: Atelier de restitution des résultats de la mission Biogaz

No. d'ordre	Nom & Prénoms	Fonction / Structure	Tél	Adresse email
1	Sow Suleymane	MicroSow	70206297	info@microsow.com
2	Diallo Valerie	AT/DED PDA	70210140	valerielh@yahoo.com
3	Traore Jacouba	Président APRET	70272694	trayac@yahoo.fr
4	Ilboudo Gérard Philippe	PAT/ASDC Méguet	76589821	Philgera4@yahoo.fr
5	Ilboudo Samuel	Coordonateur de AMPOITT	70302048 76619987	ilboudosamuel@yahoo.fr
6	Illa Abel	Controleur de qualité ASY	50341974 788860672	Illaabel2000@yahoo.fr
7	Weinzierl Stephanie	AT / DED ASY	50341974 70266287	S_weinzierl@gmy.de
8	Zomahoun Gilbert	DED BFA Coord. Dev. Rural	76672894 50342844	Gilbert.zomahoun@ded.de.bf
9	Massone Stefano	AT DED/APB	´76551587	job@stefanomadssone.it
10	Ouoba Josua	APB Poela S.P.	40779508 76491483	apb@fasonet.bf
11	Dicko B. Sadou	Repr. Eleveur Fada N'Gourma	70274456	Yeral.dicko@gmx.net
12	Sow Matioudo	Repr. Eleveur Fada N'Gourma	40770225	Yeral.dicko@gmx.net
13	Fassembedo Salam	Eveil du Faso, Consultant WINROCK Int.	78834811 76705610	eveildufaso@yahoo.com
14	Kenfack Siméon	CREPA	50366210 76542979	skenfack@yahoo.fr
15	Diop Amadou	Institut Panafricain pour le Developpemnet Afrique de l'Ouest – Sahel IPD/AOS	50364762 50364807 50364730	ipd_aos@cenatrin.bf
16	Adjaka Kouami	HILEC ET CO Consultant	50358292 73813647	hilecetco@fasonet.bf
17	Sambore Yacouba	Expert Environnment FAO	50306057 70322793	ysambore@yahoo.fr
18	Tobler Monika	FAO, Chargé de Programme Environnement	50306057 76069060	Monika.tobler@fao.org
19	Mamadou Dianka	UEMOA PRBE Coordonateur	50318873	mdianka@uemoa.int
20	Guire Hassane	Coordonateur FIIMBA	40779109 70362477	fiimba@fasonet.bf
21	Banhoro Zama	DG/SOGEAO	50358226	zbanhoro@yahoo.fr
22	Yeye Abdoulaye	PDA	70210134	yeyeabd@yahoo.fr
23	Bere André	DT SOGEAO	50358227	bereandre@yahoo.fr
24	Wereme Alhadi	IRSAT / CNRST	50357029	dirsat@fasonet.bf
25	Tandamba Thiombano M. Louise	Pres. Union ECG	70337510	ozialouisege@yahoo.fr
26	Bengaly Abdoulaye	BRS Burkina	50496047 76609409	bengalyaziz@yahoo.fr
27	Kabore Gombila	IRSAT / CNRST	70755970 76619502	legomka@yahoo.fr

No. d'ordre	Nom & Prénoms	Fonction / Structure	Tél	Adresse email
28	Mang Heinz-Peter	GTZ – CEEP	+491607112249	mang@ieep.net
29	Hebie Amadou	PAMER	50369262	amadhebie@yahoo.fr
30	Wangraoua Gilbert	Petit Séminaire de Pabré	50319501 78008501	seminairepabre@yahoo.fr
31	Ouedraogo Basile	Assistant DTA / CEAS	70214005	Pguisson@gmail.com
32	Ouedraogo Rémi B.	Conseiller Technique GTZ PDDC	78833112 70162643	Remi.ouedraogo@gtz.de
33	Bracken Patrick	Consultant GTZ	76971143	Pocb123@yahoo.com
34	Grütjen Klaus	Coordonateur GTZ IS Burkina Faso	50361040 76190001	Klaus.gruetjen@gmx.de
35	Clement Klutse	Stageaire GTZ	76262935	Clement.klutse@laperte.net
36	Huba Elisabeth-Maria	Mission d'étude GTZ	76401795	emh@unforgettable.com
37	Fall Abdoulaye	Mission d'étude GTZ	76185030	vieuxfall@yahoo.com

Annex 9: Institutions and enterprises with potential to be included in a National Biogas Dissemination Programme (NBDP)

Abbreviation	Name	Place and outreach	Resource Person Contact, Email Web site	History and Field of Action	Evaluation: Potential role within a NBDP
2iE	Institut International d'Ingénierie de l'Eau et de l'Environnement	Ouagadougou, West African Region	Pr Yézouma Coulibaly, chef de l'UTER Génie Energie industriel yezouma.coulibaly@eieretsher.org Dr Blin Joel, joel.blin@cirad.fr http://www.eieretsher.org/?lang=en	Biogas plants were installed in the site in the past; Education, training and research	Partner for training and education; provides services, in terms of engineering expertise, studies, supervision, monitoring & evaluation
AbF	Abattoir de Fada	Fada N'Gourma	Oumarou Tankoano, Agent vétérinaire Salif Tandaba , Président de l'Union des bouchers	Low capacity slaughterhouse with big problems due to the large amounts of waste water and organic waste	Potential operator of biogas plant
AGED	Association pour la Gestion de l'Environnement et le Développement	Ouagadougou, Sahel, Est and Centre region	Boureima Zeza Drabo, Coordinateur dboureima@hotmail.com	ONG, working with German cooperation on livestock and natural resource management; Capacity building, research & development	Local partner for awareness raising, information, training
APFG	Association pour la Promotion Feminine de Gaoua	Gaoua and Poni province, Sud Ouest region	Hien Youl Yeri Viviane Youl Edith	Women group engaged in micro-business & micro finance Capacity building, social, economic & ecological development	Local partner for awareness raising, information, marketing and user training
APRET	Association pour la protection et la restauration de l'environnement	Ouagadougou & 26 villages in northern and eastern regions	Yacouba Traoré, President Trayac2004@yahoo.fr	National Association for technical support Campaigns for human rights, environmental & health concerns Reforestation, alphabetisation	Local partner for awareness raising, information, marketing and user training

Abbreviation	Name	Place and outreach	Resource Person Contact, Email Web site	History and Field of Action	Evaluation: Potential role within a NBDP
ARFA	Association pour la Recherche et la Formation en Agro-écologie		Mathieu Sawadogo, Directeur arfa@fasonet.bf	Farm serving as training centre with facilities allowing to cater students training and capacity building	Partner for information, training and demonstration site for biogas plant.
ASDC	Association Solidaire pour un Développement Communautaire	MEGUET	Pierre Kaboré, coordonnateur asdc@fasonet.bf Gérard Ilboudo, appui technique	A ONG with international support such as DED, working with farmers Community based development	Potential partner for capacity building and awareness raising
ASI	ActionStream International	Ouagadougou	Mme Nébié, Représentante sconombo@yahoo.fr	Consulting enterprise supporting communities in emerging economies through approaches which are sustainable and conducive to rapid results; policy & strategy aspects pertaining to investment dimensions; jobs for growing populations through SMEs, RE for rural communities.	Interested in collaboration by implementation as PPP project
ASY	Association Songtaab-Yalgré	Ouagadougou	Marcéline Ouédraogo, Présidente Mme Stéphanie, DED songtab@fasonet.bf www.songtaaba.net	Association of women involved in shea processing, with support of DED. It has been the first in Burkina Faso to produce an organic certified shea butter**,** **Karibio**, working with more than 11 villages and more than 3.100 women.	Interested in biogas technology for the treatment of waste water and waste by replacing septic tanks; aims to play a role in information and sensibilisation at neighbourhood and village level

Abbreviation	Name	Place and outreach	Resource Person Contact, Email Web site	History and Field of Action	Evaluation: Potential role within a NBDP
BACB	Banque Agricole et Commerciale du Burkina Faso	Ouagadougou and country wide in regional and provincial capitals	M. Séraphin Koalaga, Directeur Général Adjoint 50 33 33 33	Bank institute with largest network Credit system for farmers, and consumer credits	Given its presence at provincial level, the BACB could play an important role in the credit & subsidy system for biogas
BAFP 96	Bureau d'Appui en Santé Publique	Ouagadougou	Dr Joseph Catraye, Directeur jcatraye@basp96.org	Studies, surveys on health aspects	Interested in M&E in terms of health
BIB	Banque Internationale du Burkina Faso	Ouagadougou and country wide	Dr Kintin Frédéric Nacanabo, Chef d'agence à Fada	Bank institute with large network Credit system for industries, and consumer credits	Given its presence at each administrative level, the BIB could play an important role in the credit biogas constructors and promotors
BRS	Banque Régionale de Solidarité	Ouagadougou, And UEMOA region wide	Tinbéni LANKOANDE Directeur du Crédit brsdg@fasonet.bf	New Bank institute with UEMOA funds, represented in all UEMOA country members Credit system for programs and projects on poverty reduction, conservation of natural resources, agricultural development, including farm equipment, & consumer credits	Given its presence at the regional level, the BRS could play an important role in the credit & subsidy system for biogas
CEAS	Centre Ecologique Albert Schweitzer	Ouagadougou	Pierre Guissou, Chef du Département Technologies Appropriées ceas-rb@fasonet.bf http://www.ceas-ong.net/burkina1.html	ONG involved in food processing applying renewable energy technologies Education, training and research & development, Technical assistance to associated farmers	Partner for training of craftsmen and users, awareness raising

Abbreviation	Name	Place and outreach	Resource Person Contact, Email Web site	History and Field of Action	Evaluation: Potential role within a NBDP
CIFAME	Commission Intersectorielle de Facilitation de l'Approche Multisectorielle dans le domaine de l'Energie	Ouagadougou and country wide	Jean Paul Laude, Conseiller technique du Ministre Balla Moussa Ouattara, Directeur de l'énergie électrique	Hosted within the Ministry of Energy and Mines, the "*CIFAME concept*" formerly appeared by the end of the nineties under the shape of an Energy Commission meant to serve as a forum including the most concerned sectors like the ministries of trade, finances, environment and all relevant partners (whether formal or informal) such as the electricity company, industrial operators' organizations, banks and consumers' associations...	Partner for awareness raising at all levels, particularly at policy and decision makers level
CPR	Centre de Promotion Rurale / PK60	Fada N'Gourma and East Region	Pascal Bourbou, Directeur Raymond Zemba, coordonateur pédagogique Seydou Zoungrana, chargé des finances	There are 6 CPR in Burkina Faso involved in the education and training of young rural people (14 – 18 years old) in the fields of agriculture, livestock, handicraft	Partner for training of young farmers and extension technicians; potential demonstration site for biogas

Abbreviation	Name	Place and outreach	Resource Person Contact, Email Web site	History and Field of Action	Evaluation: Potential role within a NBDP
CRA	Chambre Régionale de l'Agriculture de l'Est	Fada N'Gourma and East Region	Sow Makido, Président de l'Union des éléveurs Louise Tandaba, Présidente de l'Union des éléveurs de porcs Amado Dioni, Membre du groupement vaches laitières J.P Thiombiano, Secrétaire général de la Chambre régionale de l'agriculture de l'Est Ousmane Maïga, éleveur Nouhoun Dicko, éleveur Abdoul Karim Traoré, éleveur	Organisation supporting the integration of the agricultural and livestock sector; networking with breeder associations	Access to potential programme participants and potential group leaders for sensibilisation, information and marketing. CRA could be an example for sister organizations in the other 12 regions of the country how to integrate biogas technology within the intended common agriculture-livestock-infrastructure
CREPA	Centre Regional pour l'eau potable et l'assainissement à faible coût	Ouagadougou, country wide and in the West African Region	Dr. Simeon Kenfack, Head of Research Dpt GIEUE crepa@fasonet.bf	Founded in 1988 with members in 17 West African countries Intending to stop poverty by developing and implementing low cost technologies for drinking water supply, waste water treatment and re-use.	Partner for information and training; communication to CREPA members in other countries; interested in standardization and quality control

Abbreviation	Name	Place and outreach	Resource Person Contact, Email Web site	History and Field of Action	Evaluation: Potential role within a NBDP
DED	Deutscher Entwicklungsdienst	Ouagadougou and country wide, if requested	Suzanne Gentges, Directrice du DED suzanne.gentges@ded.de Gilbert Zomahoun, Coordinateur Développement Rural gilbert.zomahoun@ded.de	Capacity building of local communities including technologies and management issues	Potential partner for coordination, training, awareness raising, marketing strategy
DEP/MS	Direction Etudes et Planification/ Ministère de la Santé	Ouagadougou and country wide	Landrim Boussary	Studies, surveys on hygiene aspects	Interested in M&E in terms of hygiene, particularly when septic tanks were replaced by biogas digesters
DGRE/DA/MAHRH	Direction Générale des Ressources en Eau / Direction Assainissement / Ministère de l'Agriculture, de l'Hydraulique et des Ressources Halieutiques	Ouagadougou and country wide	Zounoubaté N'Zombié, Directeur nzounoubate@yahoo.fr dgre.da@yahoo.fr	Administration in charge of sanitation services in rural areas	Interested in biogas technology for the treatment of domestic waste water and faecal sludge, replacing septic tanks by biogas digesters
DHP/MS	Direction de l'Hygiène Publique / Ministère de la Santé	Ouagadougou and country wide	Yaya Ganou, Directeur dhpes_sante@yahoo.fr imbeganou@yahoo.com	Administration, studies, surveys on hygiene aspects	Interested in M&E in terms of hygiene when septic tanks are replaced by biogas digesters

Abbreviation	Name	Place and outreach	Resource Person Contact, Email Web site	History and Field of Action	Evaluation: Potential role within a NBDP
DP/MO	Direction de la Propreté / Mairie de Ouagadougou	Ouagadougou	Sidi Mahamadou Cissé, Directeur cisse_sidi@yahoo.com	Administration; Municipal solid waste management	Interested in biogas technology for the treatment of solid waste and faecal sludge from septic tanks
DRA/MAHRH	Direction Régionale de l'Agriculture / Ministère de l'Agriculture, de l'Hydraulique et des Ressources Halieutiques	Fada N'Gourma and East Region	Gandia Lompo, Directeur par intérim	Regional representation of the Ministry of Agriculture	Interested in supporting National Domestic Biogas Programme in order to restore soil fertility
DRECV/MECV	Direction régionale de l'Environnement et du cadre de vie / Ministère de l'Environnement et du cadre de vie	Fada N'Gourma and East Region	Sibiri Kaboré, Directeur régional Gustave Yaméogo, Directeur provincial, Jean Bosco Sow , Chargé du PROGEREF à l'est jeanboscoso@hotmail.com	See MECV	See MECV

Abbreviation	Name	Place and outreach	Resource Person Contact, Email Web site	History and Field of Action	Evaluation: Potential role within a NBDP
DRRA/MRA	Direction Régionale des Ressources Animales / Ministère des Ressources Animales	Fada N'Gourma and East Region	Drissa Salou, Directeur régional Amado Nikiéma, responsable de la ferme de Kikidéni	Regional representation of the Ministry of Animal Resources; in charge of animal resource production and livestock management	Potential partner for improvement of livestock husbandry. Interested in Biogas as "trigger" of the intensification process being encouraged and supported in the region. The Station of Kikidémi could be used as training pilot site for biogas plants
ENEF	Ecole National des Eaux et Forets	Bobo-Dioulasso, country wide and West Africa	Ouedraogo Joachim, Director	Founded in 1953, well equipped centre for professional training of technicians and engineers in water, forest and environmental issues; receives students from all West African countries; maintains a alumni network, which includes in the meantime also high level politicians	Could play a central role in training and marketing, as well as policy development
EF	Groupement « Eveil du Faso » – Winrock International	Ouagadougou	M. Samuel Zongo Salam Tassembedo eveildufaso@yahoo.fr	Association of handicraftsmen Training on bio fuel issues	Interested in capacity building of craftsmen
ER AMPO	Ecole Rurale AMPO	Balkui / Ouagadougou	Samuel Ilboudo, Directeur	Supported by Luxembourg and DED, the school is dedicated to education and training of young rural people in the fields of agriculture, livestock	Partner for user and constructor training; potential demo site for biogas technology
FAFASO	Foyer Amélioré du Faso	Ouagadougou & country wide	Dr. Andrea Reikat	Dissemination programme for improved wood saving stoves	Partnering in dissemination

Abbreviation	Name	Place and outreach	Resource Person Contact, Email Web site	History and Field of Action	Evaluation: Potential role within a NBDP
FAO	Food and Agriculture Organisation	Ouagadougou	Marie Noel Koyara, Représentante nationale Monika Tobler, Cadre associée Monika.tobler@fao.org	FAO has initiated a pre-feasibility study on biogas potential in Burkina Faso regarding food security	Strongly interested in collaboration; could provide support in identifying potential sites for the implementation
FICOD	Fonds d'Investissement pour les Collectivités Décentralisees	Ouagadougou – Gaoua – Fada N'Gourma	Mr. Abdoulaye Zongo, GS Mr. Edzard Nebe, GM ficod@liptinfor.bf	Financial Cooperation Burkina Faso – Germany: co-Financing projects selected as priority by decentralized municipalities: market infrastructure, public services, social infrastructure	In case municipalities decide to implement biogas digesters as wastewater treatment plants, FICOD would join in the co-financing mechanisms
FIIMBA		Bogande and Gnagna province	Mr. Guire Hassane	Local acting association with settled infrastructure and recognition in the population	Access to potential biogas clients, awareness raising, marketing, micro-finance administration, craftsmen training and control
GovF	Gouvernorat de Fada	Fada N'Gourma and East Region	Kilimité Hien	Administration Representative of the State at the Region level	Political support
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit	Ouagadougou, Est and Sud-Ouest Regions	Marina Mdaihli, Directrice marina.mdaihli@gtz.de www.gtz.de	German Technical Cooperation	Potential partner through its current programmes, esp. PDA & PDDC
GTZ-IS	Deutsche Gesellschaft für Technische Zusammenarbeit – International Services	Ouagadougou	Klaus Gruetjen, Coordinateur klaus.gruetjen@gtz.de Siaka Koné	Capacity building of institutions esp. in management and administrative issues	Potential partner for the programme coordination

Abbreviation	Name	Place and outreach	Resource Person Contact, Email Web site	History and Field of Action	Evaluation: Potential role within a NBDP
HCF	Haut Commissariat de Fada	Fada N'Gourma and its Province	Kalil Bara, Haut-Commissaire Orokia Onadja Barro, SG	Representative of the Central Government at provincial level	Political support
HILEC & CO	HILEC & CO sarl		Adjaka Kouami, Directeur hilecetco@fasonet.bf	Private enterprise: consulting on electricity issues	Interested in broadening own knowledge in RE sector; access to potential rural clients for biogas;
INERA	Institut de l'Environnement et de Recherches Agricoles	Ouagadougou Country wide	Adama Siénou, Chercheur sienou@hotmail.com Binta Diallo, Chercheur inera.direction@fasonet.bf www.inera.bf	biogas plants were installed in the Saria Experimental Centre in the past; high level education, training and scientific engineering research; 2iE provides services by engineering expertise, studies, monitoring & evaluation	Potential partner for technical training and engineer education, as well as in standardization & quality control
IP	Iles de Paix	Fada N'Gourma	Gaël de Bellefroid, Coordinateur résident projets@ilesdepaix.org http://www.ilesdepaix.org/	ONG from Belgium aiming to support the development of small communities, main focus: water supply	Potential partner for capacity building and awareness raising at local level
IPD/AOS	Institut panafricain pour le développement / Afrique de l'Ouest et Sahel	Ouagadougou with African representations	Amadou Diop, Directeur ipd_aos@cenatrin.bf / diopam@hotmail.com	Regional training centre with adapted facilities and infrastructure to cater students; Capacity building, training	Potential partner for capacity building and awareness raising at technician level. Interested in biogas technology for the treatment of all wastewater streams from the centre and other facilities

Abbreviation	Name	Place and outreach	Resource Person Contact, Email Web site	History and Field of Action	Evaluation: Potential role within a NBDP
IRSAT	Institut de Recherches en Sciences Appliquées et Technologies	Ouagadougou	Dr. Alhadi Wereme, Directeur Dr. Oumar Sanogo, chef du département Energie sanogo_oumar@hotmail.com	As former Institut Burkinabé de l'Energie (IBE), installed biogas plants throughout the country R&D on renewable energy	Partner for quality control, standardisation and training
ISOMET	Innovation en Solaire et Métallique	Ouagadougou	William Ilboudo, Directeur isomet@zcp.bf	Private enterprise; currently focussing on solar energy issues, production of solar energy appliances	Interested in broadening its own capacity in the RE sector and in potential complementarities between solar energy and biogas; potential producer of biogas appliances
LNBTP	Laboratoire National du Bâtiment et Travaux Publics	Bobo-Dioulasso and country wide	Kiemtore Serge	Responsible for setting and monitoring standards in the construction sector	Has to be considered as strategic partner for standardization and quality control
MAHRH	Ministère de l'Agriculture, de l'Hydraulique et des Ressources Halieutiques	Ouagadougou	Sécrétaire Général	Administration	Potential member of the Programme Steering Committee
MECV	Ministère de l'Environnement et du Cadre de Vie	Ouagadougou	Alain Edouard Traoré, Secrétaire Général Athanase Zéphirin Ouédraogo, Directeur de l'assainissement et de la prévention des pollutions et des nuisances	Governmental authority in charge of environmental issues in the country	The implementing process could be under the responsibility of this Ministry

Abbreviation	Name	Place and outreach	Resource Person Contact, Email Web site	History and Field of Action	Evaluation: Potential role within a NBDP
MicroS	MicroSow	Ouagadougou	Souleymane Sow, Directeur info@microsow.com	Private enterprise; currently focussing on solar energy issues; production of solar energy appliances	Interested in broadening its own capacity in the RE sector and in potential complementarities between solar energy and biogas; potential producer of biogas appliances
MMCE	Ministère des Mines, des Carrières et de l'Energie	Ouagadougou	Bassirou Ouédraogo, Directeur de l'Energie bass_msgo@yahoo.fr	Governmental authority in charge of energy in the country	The Programme Steering Committee could be led by this Ministry
MRA	Ministère des Ressources Animales	Ouagadougou	P. Bernard Konkobo konkobobernard@yahoo.fr Jean-Paul Rouamba jrouamba@yahoo.fr	Governmental authority in charge of national livestock policies and developments	Important potential member of the Programme Steering Committee
ONEA	Office National de l'Eau et de l'Assainissement	Ouagadougou and country wide	M. Arba Jules Ouédraogo, Directeur de l'Assainissement dass.onea@fasonet.bf	Service provider in terms of water and sanitation Administrative body in charge of water supply and sanitation in urban areas	Interested in biogas technology for the treatment of domestic waste water and faecal sludge, replacing septic tanks by biogas digesters
PAMER	Projet d'Appui aux Micro-Entreprises rurales	Ouagadougou and the regions East and West	Guy Raoul Sanon, Coordonnateur pamer@pamer.fidafrique.org Mr. Hébié, chargé du suivi-évaluation www.pamer.fidafrique.org	Launched in 2001 with support of IFAD, the project aims to develop the entrepreneurship in rural areas Capacity building and technical support to Small and Medium Enterprises in rural areas	Could play an important role in: entrepreneurship development, capacity building, access to micro-finance, marketing strategies, M&E

Abbreviation	Name	Place and outreach	Resource Person Contact, Email Web site	History and Field of Action	Evaluation: Potential role within a NBDP
PDA / GTZ	Programme Développement Agricole / GTZ	Ouagadougou, East Region and South-West Region	Florent-Dirk Thies, Coordinateur florent-dirk.thies@gtz.de Andrea Wilhelmi-Somé, Assistante andrea.wilhelmi-some@gtz.de	Programme of GTZ aiming to reduce poverty in rural areas, by capacity building of farmers for improvements of agricultural activities, including stable and compost use	Could identify rural locations with potential for biogas; important role in information and sensibilisation at the local level
PDDC / GTZ	Programme Décentralisation et développement Communal / GTZ	Ouagadougou	Rémi Ouédraogo, chargé du renforcement de capacité / infrastructure gtz-decentralisation@fasonet.bf	Programme of GTZ supporting capacity building in planning processes of decentralized communities	Partner for information and advices on capacity building of institutions
PICOFA	Programme d'Investissement Communautaire en Fertilité Agricole	Fada and East Region	Jacob Ouédraogo, Coordonnateur National picofa@fasonet.bf Réné Yonli, Responsable administratif et financier André Oula Ouattara, Chargé de suivi évaluation oullaandre@yahoo.fr Moussa Toé, Ingénieur du Génie Rural picofa@fasonet.bf www.picofa-bf.org	National programme with the support of IFAD supporting farmers to manage soil fertility Implementation of compost plants at the regional level (East Region)	Potential partner for capacity building, M&E during the implementation
PNUD	Programme des Nations-Unies pour le Développement		Clarisse Coulibaly, Coordinatrice clarisse.coulibaly@undp.org	Environment and Energy	Potential member of the Programme Steering Committee

Abbreviation	Name	Place and outreach	Resource Person Contact, Email Web site	History and Field of Action	Evaluation: Potential role within a NBDP
PSB	Petit séminaire de Pabré	Ouagadougou - Kamboansé	Abbé Gilbert Ouangrawa wanggil@yahoo.fr , seminairepabre@yahoo.fr Francis Pezingo pezingo@yahoo.fr	Boarding School with a big farm, where 2 biogas plants were installed in 1982 and maintained until 1995	Partner for information, training and demonstration site for biogas technology
PTFM	Programme National de Plate-formes Multifonctionelles pour la Lutte contre la Pauvreté	Ouagadougou - country wide	Honoré Bonkoungou, Coordonnateur Cellule d'Appui Conseil (CAC) Tintua – Est courrier@tintua.org pn-ptf@fasonet.bf http://www.ptfm.net http://www.tintua.org/	Governmental programme for poverty reduction supported by PNUD; focussing on water and energy supply to overcome poverty in rural areas	Partner for awareness raising, marketing strategy and training; access to potential biogas customers
RCPB	Resau des Caisses Populaires du Burkina	Ouagadougou – country wide at commune level	Daouda SAWADOGO, Directeur Général, 01 BP 5382 Ouaga 01 daoud_sawa@hotmail.com	Bank institute with largest network: offers credit system for farm equipment and consumer credits	Given its presence at each administrative level, the RCPB could play an important role in the credit & subsidy system for biogas dissemination
SNV	Dutch Agency for Cooperation	Ouagadougou	Jean-Marc Siaka, Conseiller senior jclappers@snvworld.org burkina-faso@snvworld.org http://www.snvworld.org www.snvburkina.org	Netherland-based, international development organisation that provides advisory services to those who can not afford consultancy services	Potential partner in programme implementation; capacity building for institutional development

Abbreviation	Name	Place and outreach	Resource Person Contact, Email Web site	History and Field of Action	Evaluation: Potential role within a NBDP
SOGEAO	Société de Gestion de l'Abattoir de Ouagadougou	Ouagadougou	Dr André Béré, Directeur Technique bereandre@yahoo.fr	Largest slaughterhouse in the country with big problems with the large amounts of waste water and organic waste	Potential client for biogas technology as example for the other slaughterhouses in the country
UEMOA	Union Economique et Monétaire de l'Afrique de l'Ouest	Ouagadougou, Region West Africa	Mamadou DIANKA, Coordinator Programme Biomass Energy mamadou.dianka@uemoa.int	Regional organisation, which is aware of required changes in energy policies at national and West African regional level; aimed to initiate pre-feasibility studies on biogas potential in UEMOA country members: policy & strategy developments, financing & fund raising	Potential partner for co-financing NDBP as well as feasibility studies in other UEMOA countries
YEMB	Groupement Yemboado	Fada N'Gourma	Mme Christine Balima Lompo chrisbalima@yahoo.fr	Cooperative of women involved in shea processing to produce soap Soap production	Potential participant in NDBP as client and as local group leader for sensibilisation, information and marketing.

Annex 10: Resource persons related to biogas in Burkina Faso

Nr.	Title	NAME	First Name	Institution	City
1	Mme		Aurélie	Laiterie Dano	Dano
2	Mme		Stéphanie	ASY	Ouagadougou
3	Mr.	ADJAKA	Kouami	HILEC & co s.a.r.l.	Ouagadougou
4	Mr.	AMEGHRAN	Cyril	CREPA	Ouagadougou
5	Mr.	BADO	M.	Workshop gas stoves	Ouagadougou
6	Mr.	BADOLO	Loussir	PDDC GTZ	Ouagadougou
7	Mr.	BELEMVIRE	Seydou	Hôpital	Bogande
8	Mr.	BERE	André	SOGEAO	Ouagadougou
9	Mr.	BLIN	Joël	2ie	Ouagadougou
10	Mr.	BONDE	Mossi	CFFA Farako-Ba	Farako
11	Mr.	BONI	D. Jean Martin	CFFA Farako-Ba	Farako
12	Mr.	BONKOUNGOU	Honoré	PTFM / Tintua Est	Fada N'Gourma
13	Mr.	BONOU	Victorien	Commune de Ouagadougou	Ouagadougou
14	Dr.	BONZI	Moussa	Centre de SARIA / INERA	Koudougou
15	Mr.	BORO	Assimi	Mairie de Bogande	Bogande
16	Mr.	BOURBOU	Pascal	CPR PK60	Fada N'Gourma
17	Mr.	BOUSSARY	Landrim	DEP/Min. Santé	Ouagadougou
18	Mr.	CATRAYE	Joseph	BASP 96	Ouagadougou
19	Mr.	CISSE	Sidi Mahamadou	Mairie de Ouaga	Ouagadougou
20	Mme	COLY	Annette	Ambassade Allemagne	Ouagadougou
21	Mr.	COULIBALY	Pr. Yezouma	2ie	Ouagadougou
22	Mme	COULIBALY	Clarisse	PNUD	Ouagadougou
23	Mr.	DEMBELE	Kassoum	PABSO	Bobo-Dioulasso
24	Mr.	DAGERSKOG	Linus	CREPA	Ouagadougou
25	Mr.	DAMOLGA	David	APB	Piela
26	Mr.	DE BELLEFROID	Gaël	Iles de Paix	Fada N'Gourma
27	Mr.	DIALLO	Alassane	DSONG	Ouagadougou
28	Mr.	DIALLO	Mamadou	UPE-IOBA	Dano
29	Mme	DIALLO	Valerie	PDA GTZ	Ouagadougou
30	Mr.	DIANKA	Mamadou	UEMOA	Ouagadougou
31	Mme	DIATO		UICN	Ouagadougou
32	Mr.	DIONI	Labdane	MRA	Bogande
33	Mr.	DIONI	Amado	Producteurs de lait	Fada N'Gourma
34	Mr.	DIOP	Amadou	IPD/AOS	Ouagadougou
35	Mr.	Djibo	Ousmane	PDA / GTZ	Ouagadougou
36	Mr.	DRABO	Boureima Zeza	AGED	Ouagadougou
37	Mr.	FAHO	Ousmane	Lycée Boromo	Boromo
38	Mr.	GANOU	Yaya	DHP/Min. Santé	Ouagadougou
39	Mme	GENTGES	Suzanne	DED	Ouagadougou
40	Mr.	GNIENHOUN	Oscar	Lycée Boromo	Boromo
41	Mr.	GRUETJEN	Klaus	GTZ-IS	Ouagadougou
42	Mr.	GUIRE	Hassane	Fiimba	Bogande
43	Mr.	GUISSOU	Pierre	CEAS	Ouagadougou
44	Mr.	HEBIE		Chambre de Com., Ind., Artisanat	Ouagadougou
45	Mr.	HIEN	Kilimité	Gouvernorat de Fada	Fada N'Gourma
46	Mme	HIEN	Youl Yeri Viviane	APFG	Gaoua

Nr.	Title	NAME	First Name	Institution	City
47	Mr.	ILBOUDO	William	ISOMET sarl	Ouagadougou
48	Mr.	ILBOUDO	Samuel	Ecole Rurale AMPO	Balkui
49	Mr.	ILBOUDO	Idrissa	DRA/MAHRH	Fada N'Gourma
50	Mr.	KABORE	Augustin	ENEF	Bobo-Dioulasso
51	Mr.	KABORE	Gombila	IRSAT	Ouagadougou
52	Mr.	KABORE	Sibiri	MECV	Fada N'Gourma
53	Mr.	KABORE	Pierre	ASDC	Méguet
54	Mme	KABORE		FAFASO GTZ	Ouagadougou
55	Mr.	KABRE	Michel K.	CET	Koudougou
56	Mr.	KALIL	Bara	Haut Commissariat N'Gourma	Fada N'gourma
57	Mr.	KARAMBIRI	Salamata	PABSO	Bobo-Dioulasso
58	Mr.	KENFACK	Simeon	CREPA	Ouagadougou
59	Mr.	KIEMTORE	Serge	LNBTP	Bobo-Dioulasso
60	Mr.	KIENOU	Macaire	PICOFA	Bogande
61	Mr	KINTIN	Frédéric D.	BASP 97	Ouagadougou
62	Mr.	KIS	Jean	PABSO	Bobo-Dioulasso
63	Mr.	KOALAGA	Séraphin	BACB	Ouagadougou
64	Mr.	KONKOBO	P. Bernard	MAR	Ouagadougou
65	Mme	KOYARA	Marie Noel	FAO	Ouagadougou
66	Mr.	LAENBA	Alexandre	PDA GTZ	Diebougou
67	Mr.	LANKOANDE	Simon	APB	Piela
68	Mr.	LANKOANDE	Charles	APB	Bilanga
69	Mr.	LANKOANDE	Tinbéni	BRS	Ouagadougou
70	Mr.	LAUDE	Jean Paul	CIFAME, MMCE	Ouagadougou
71	Mr.	LOMPO	Christine Balima	Groupement Yemboado	Fada N'gourma
72	Mr.	MASSONE	Stefano	DED/APB	Piela
73	Mme	MDAIHLI	Marina	GTZ Bureau	Ouagadougou
74	Mr.	MEENINK	Hans J.W.	SNV Burkina Faso	Bobo-Dioulasso
75	Mme	NANA	Désirée	PEA / GTZ	Ouagadougou
76	Mr.	NANA NOBILA	Jean-Baptiste	MECV	Bogande
77	Mr.	NEBE	Edzard	FICOD	Ouagadougou
78	Mme	NEBIE		Action Stream International	Ouagadougou
79	Mr.	NIKIEMA	Etienne	DPRA-IOBA	Dano
80	Mr.	NONY ARMA	Emmanuel	CIFAME	Ouagadougou
81	Mr.	N'ZOUMBIE	Zounoubate	Direction Assainissement/MAHRH	Ouagadougou
82	Mme	ONADJA BARRO	Orokia	Haut Commissariat N'Gourma	Fada N'Gourma
83	Mr.	OUANGRAOUA	Rasmané	Gouverneur	Gaoua
84	Mr.	OUATTARA	Alhamadoga	ASUDEC	Diebougou
85	Mr.	OUATTARA	Balla Moussa	CIFAME	Ouagadougou
86	Mr.	OUATTARA	André Oulla	PICOFA	Fada N'Gourma
87	Mr.	OUATTARA	Moussa	MMCE	Ouagadougou
88	Mr.	OUEDRAOGO	Bassirou	MMCE	Ouagadougou
89	Mr.	OUEDRAOGO	O. Prosper	MRA	Gaoua
90	Mr.	OUEDRAOGO	Joachim	Ecole Nat. Eaux & Fôrets	Bobo-Dioulasso
91	Mr.	OUEDRAOGO	Arba Jules	ONEA	Ouagadougou
92	Mr.	OUEDRAOGO	Rémi B.	PDDC GTZ	Ouagadougou
93	Mme	OUEDRAOGO	Marcéline	ASY	Ouagadougou

Nr.	Title	NAME	First Name	Institution	City
94	Mr.	OUEDRAOGO	Athanase Zéphirin	MECV	Ouagadougou
95	Mr.	OUEDRAOGO	Jacob	PICOFA	Fada N'Gourma
96	Mr.	OUEDRAOGO	Joseph	PDA / GTZ	Fada N'Gourma
97	Mr.	OUOBA	Josue	APB	Piela
98	Mme	PELETIER		EU Energy Facility	Ouagadougou
99	Mr.	PEZINGO	Francis	Petit Seminaire	Pabré
100	Mme	REIKAT	Andrea	FA-FASO	Ouagadougou
101	Mr.	ROUAMBA	Jean-Paul	MAR	Ouagadougou
102	Mr.	ROUAMBA	Moussa Barthelemy	Haut Commissaire	Bogande
103	Mr.	SALOU	Drissa	DRRA/MRA	Fada N'Gourma
104	Mr.	SAMBORE	Yacouba	SamConsult	Ouagadougou
105	Mr.	SANOGO	Oumar	IRSAT	Ouagadougou
106	Mr.	SANON	Guy Raoul	PAMER	Ouagadougou
107	Mr.	SAVADOGO	Karim	CREPA	Ouagadougou
108	Mr.	SAVADOGO	Somaila	MAHRH	Bogande
109	Mr.	SAWADOGO	Arouna	UPE-IOBA	Dano
110	Mr.	SAWADOGO	K. Sylvain	MECV	Gaoua
111	Mr.	SAWADOGO	Daouda	RCPB	Ouagadougou
112	Mr.	SAWADOGO	Mathieu	ARFA	Ouagadougou
113	Mr.	SAWADOGO	Oumarou	PDA GTZ	Gaoua
114	Mr.	SCHOPFERER	Hermann	PABSO	Bobo-Dioulasso
115	Mr.	SECHAUD	Laurent	CAGEC Coopération Suisse	Ouagadougou
116	Mr.	SEONE	Hamidou	PABSO	Bobo-Dioulasso
117	Mr.	SEYI	Foudou	DED/APB	Piela
118	Mr.	SIAKA	Koné	GTZ-IS	Ouagadougou
119	Mr.	SIENOU	Adama	INERA	Fada N'Gourma
120	Mr.	SIKA	Jean-Marc	SNV	Ouagadougou
121	Mr.	SOME	Balyao	VARENA	Diebougou
122	Mr.	SOME	B. Joel	Association TBL	Diebougou
123	Mr.	SOME	Jules	PDA GTZ	Ouagadougou
124	Mr.	SOME	T. Adolphe	Caisse Populaire	Gaoua
125	Mr.	SONDE	Amadoum	Caisse Populaire	Diebougou
126	Mr.	SOULI	Sibiri	MECV	Bogande
127	Mr.	SOW	Jean Bosco	MECV	Fada N'Gourma
128	Mr.	SOW	Souleymane	MicroSow	Ouagadougou
129	Mr.	SOW	Maquido	URGrE	Fada N'Gourma
130	Mr.	STOUPY	Olivier	PEA / GTZ	Ouagadougou
131	Mme	TANDABA	Louise	Union des Eléveurs de porcs	Fada N'Gourma
132	Mr.	TANDABA	Salif	Union des bouchers	Fada N'Gourma
133	Mr.	TANKOANA	Taladidia	Fiimba	Bogande
134	Mr.	TANKOANO	Oumarou	Abattoir de Fada	Fada N'gourma
135	Mr.	TASSEMBEDO	Salam	Eveil du Faso/Winrock Inter.	Ouagadougou
136	Mr.	THIAM	Mael	IAEM	Ouagadougou
137	Mr.	THIES	Florent Dirk	PDA / GTZ	Ouagadougou
138	Mr.	THIOMBIANO	J. P.	CRA Région de l'Est	Fada N'gourma
139	Mme	TOBLER	Monika	FAO	Ouagadougou
140	Mr.	TOE	Moussa	PICOFA	Fada N'Gourma

Nr.	Title	NAME	First Name	Institution	City
141	Mme	TONE	Agathe	BACB	Ouagadougou
142	Ms	TRAORE	Leocadia	IRSAT, FA-FASO	Ouagadougou
143	Mr.	TRAORE	Yacouba	APRET	Ouagadougou
144	Mr.	TRAORE	Alain Edouard	MECV	Ouagadougou
145	Mr.	TRAORÉ	Alain	AGED	Ouagadougou
146	Mme	VAN DER WAALS	Renet	Ambassade Pays-Bas	Ouagadougou
147	Mr.	WANGRAOUA	Gilbert	Petit Seminaire	Pabré
148	Mr.	WEREME	Alhadi	IRSAT	Ouagadougou
149	Mme	WILHELMI-SOME	Andrea	PDA / GTZ	Ouagadougou
150	Mr.	YAMEOGO	Gustave	MECV	Fada N'Gourma
151	Mr.	ZOMAHOUN	Gilbert	DED	Ouagadougou
152	Mr.	ZONGO	Paul	MRA	Ouagadougou
153	Mr.	ZONGO	Samuel	Eveil du Faso/Winrock Inter.	Ouagadougou
154	Mr.	ZONGO	Abdoulaye	FICOD	Ouagadougou

Annex 11: Bibliography

Year	Author / Editor	Title	Country / web site
NY	Perumal, G. et al.	Biogas Technology – profiles and problems of acceptance	International
NY	Sasse, Ludwig	Evaluation of biogas programmes – Methodology and criteria	Germany
NY	Government of Burkina Faso, United Nations Development Program Global – Environment Fund PROGEREF	Country partnership programme on sustainable land management in Burkina Faso (cpp)	Burkina Faso
2007	ASDC	Association Solidarité pour un développement communautaire, Meguet / Ganzourgou	Burkina Faso
2007	Auzias, Dominique et al.	Petit Futé Burkina Faso 2007/2008	France / www.petitfute.com
2007	Banque Internationale du Burkina	BIB – l'expérience dynamique	Burkina Faso
2007	Biogas for Better Life, WINROCK International	A Cost-Benefit Analysis of National and regional Integrated Biogas and Sanitation Programs in sub-Saharan Africa	The Netherlands
	Dutch Ministry of Foreign Affairs	Report on the Feasibility for a National Household Biogas Commercialization Program in Uganda	
2007	Buckley, L. – Global Environmental Institute	Biogas for Lasting Poverty Relief: Examples from a Chinese NGO	China
2007	Coopération Burkina Faso – République Fédérale d'Allemagne	Programme « Développement de l'Agriculture » P.D.A.	Burkina Faso
		Programme Décentralisation / Développement Communal (PDDC)	Burkina Faso
2007	CREPA	Gestion Intégrée des eaux usées et excréta	Burkina Faso / www.resaucrepa.org
		Appui au programme EVA (Eau pour les villes africaines) en eau et assainissement à faible cout au Burkina Faso, au Mali et au Sénégal	
2007	Ded brief Heft 1.2007	Entwicklungspartnerschaften mit der Wirtschaft	Germany
2007	FA-FASO	Liste des prix de foyers	Burkina Faso
		Roumdé – y'a pas son deux	
		Presentation du Projet Foyer Amélioré	

Year	Author / Editor	Title	Country / web site
2007	FICOD	Fonds d'investissement des collectivités décentralisée & Fiche d'information sur le financement de projets	Burkina Faso
2007	Forum of Energy Ministers of Africa – FEMA	Challenges to Increasing Access to Modern Energy Services in Africa – Background Paper, Conference on Energy Security and Sustainability	Ghana, Mozambique
2007	GTZ HEP	PED – Types de foyers domestique	www2.gtz.de/hep
2007	Iles de Paix	Transitions 74 : Décentralisations – Nouvelles opportunités pour la coopération	Burkina Faso / www.ilesdepaix.ord
2007	International Monetary Fund	Burkina Faso : Letter of Intent, Memorandum of Economic and Financial Policies, and Technical Memorandum of Understanding	Burkina Faso
2007	InWent	Entwicklung + Zusammenarbeit Nr. 3 : Energiesorgen	Germany / www.inwent.org/e+z
2007	Jica Burkina Faso	Amitié & Développement – Bulletin d'information, Nr. 011	Japan / www.jica.gov.jp
2007	Kellner, Christopher	Opportunities and Limits : Biogas Technology in the Poverty Reduction Context of Developing Countries	Nepal
		Biogas Extension in Developing Countries – Presentation	Singapore
2007	Le Faso Net	Protection de l'environnement : 16000 tonnes de gaz consommés en 2006	Burkina Faso / www.lefaso.net
2007	MAHRH et al.	Vers une nouvelle stratégie du développement agricole	Burkina Faso
2007	MININFRA & SNV	Implementation Plan National Programme on Domestic Biogas in Rwanda	Rwanda & The Netherlands
2007	Ministère des Ressources Animales	Les Statistiques du secteur de l'élevage au Burkina Faso, année 2005	Burkina Faso
2007	RCPB – Réseau des Caisses Populaires du Burkina Faso	Le crédit dans votre Caisse Populaire	Burkina Faso
2007	Rural Enterprise Gateway – Knowledge Network – Business Link	Renewable Energy – What you can do on your farm	United Kingdom
2007	Schmitz, T. Et al – gtz	Feasibility Study for a National Domestic Biogas Programme in Tanzania	Tanzania

Year	Author / Editor	Title	Country / web site
2007	SNV et al.	Biogas for a better life – an African initiative	The Netherlands / www.snvworld.org
2007	UEMOA	Indice des prix a la consommation au sein de l'UEMOA – janvier 2007	Burkina Faso
2007	UN-APCAEM	Agricultural Engineering in Support of the Kyoto Protocol – The Clean Development Mechanism for Biogas Technology	China
2007	UN-ESCAP	Recent Developments in Biogas Technology for Poverty Reduction and Sustainable Development	China & Global
2007	Van Sambeck, E. et al – COOPENER Programme ECN Policy Studies	Catalogue of energy interventions – overview of key energy interventions in the DEA partner countries	Denmark
2006	Adams, S. et al, M&EED international working group	A Guide to Monitoring and Evaluation for Energy Projects	France
2006	Africa Energy Unit – The World Bank	Energy Access in Sub-Saharan Africa – A World Bank Action Plan	Africa
2006	Australian Bureau of Agricultural and Resource Economics	Fuel and Electricity Survey 2006 – Fuel Codes	Australia
2006	BRTC Chengdu , Biogas Project LGED	Design of Biogas Plant	China
2006	CEDEAO – UEMOA	Livre Blanc Pour une politique Régionale sur l'accès aux services énergétiques des populations rurales et périurbaines pour l'atteinte des objectifs du millénaire pour le développement White Paper for a Regional Policy	Nigeria / www.energy4mdg.org
2006	Centre for Environmental Economics and Policy in Africa (CEEPA), University of Pretoria	Climate Change and African Agriculture, Policy Note No. 36	South Africa / www.ceepa.co.za
2006	CILLS, PREDAS, UEMOA, GTZ, DGIS	MERS 2006 – premier marché des énergies renouvelables au Sahel et en Afrique de l'Ouest	Niger
2006	CREPA	Etude de cas Nr. 1- 5 : Promotion de l'hygiène en milieu scolaire et communautaire en Afrique de l'Ouest Promotion des postes d'eau potable et des lave-mains à l'école	Burkina Faso / www.resaucrepa.org

Year	Author / Editor	Title	Country / web site
2006	CREPA	Gestion saine des eaux usées ménagères Approche intégrée en hygiène et assainissement individuel Projet pilote de gestion des boues de vidange Latrines ecosan en materiaux locaux Info CREPA Nr. 51 : Dossier : Des produit d'assainissement pour une production agricole durable en Afrique de l'Ouest : un projet de recherche sur l'igname en Cote d'Ivoire Info CREPA Nr. 53 : Dossier : Renforcement des programmes du CREPA pour rapprocher les services d'eau, d'hygiène et d'assainissement des communautés Info CREPA Nr. 54 : Dossier : Utilisation de l'urine comme fertilisant dans la production agricole en Cote d'Ivoire ECOSAN Info ; Nr. 4; 5; 6	Burkina Faso / www.resaucrepa.org
2006	Eipper, Christoph	Umweltaspekte von Biogasanlagen	Germany
2006	EMB Erdgas Mark Brandenburg	Einspeisung von Biomethan in das Erdgasnetz aus Sicht des Gasvertriebs	Germany
2006	ENVIS Centre	Solid Waste management at slaughterhouses in India	India / www.cpcb.dehli.nic.in
2006	Entwicklung & ländlicher Raum, Heft 6	Bioenergie	www.rural-development.de
2006	European Natural Gas Vehicle Association	Response to the Review of EU biofuels directive – Energy and Transport Directorate-General – European Commission	Europe
2006	FEWS NET	Burkina Faso Monthly Food Security Update, December 2005	Burkina Faso
2006	GTZ ecosan program	Capacity building for ecological sanitation	www.gtz.de/ecosan
2006	Iles de Paix	Rapport d'activités 2005 Transitions 70	www.ilesdepaix.ord
2006	INFORSE – International Network for Sustainable Energy	Manual on Sustainable Energy Solutions for Poverty Reduction in South Asia	www.inforse.org/asia/

Year	Author / Editor	Title	Country / web site
2006	Jenbacher	Energy Potential of Biomass	Austria
2006	Le Président du Faso, Président du Conseil des Ministres	Décret Nr. 2006-242/PRES/PM/MAHRH portant organisation du Ministère de l'agriculture, de l'hydraulique et des ressources halieutique	Burkina Faso
2006	Ministère de l'administration territoriale et de la décentralisation & GTZ	Programme Décentralisation / Développement Communal PDDC – gtz	Burkina Faso
2006	Ministère de l'agriculture, de l'hydraulique et des ressources halieutiques	PICOFA – Programme d'investissement communautaire en fertilité agricole	www.picofa-bf.org
2006	Ministère de l'agriculture, de l'hydraulique et des ressources halieutiques	PADAB II –programme d'appui au développement de l'agriculture du Burkina Faso – composante développement rural décentralisé	Burkina Faso
2006	Ministère des Mines, des carrières et de l'énergie – Secrétariat Général – Direction Générale de l'énergie	ARRETE nr. 06-021/MCE/SG/DGE : Portant création, organisation et fonctionnement de la Commission Intersectorielle de facilitation de l'Approche Multisectorielle dans le domaine de l'Energie (CIFAME)	Burkina Faso
2006	PNUD & Programme National Plates-Formes Multifonctionelles pour la lutte contre la pauvreté	PTFm'Info Nr. 001	Mali / www.ptfm.net
2006	PREDAS	Quatrième Réunion du Comité Régional de Pilotage du PREDAS	Burkina Faso
2006	Radlinger, G – Erdgas Schwaben	Erdgas und Biogas – technische und wirtschaftliche Aspekte aus Sicht der Energieversorgungsunter-nehmen: Biogas – Chance oder Risiko fuer Gasversorgungsunter-nehmen?	Germany
2006	Rural Development Service	Revised Calculation of Livestock Units for Higher Level Stewardship Agreements – Technical Advice Note 33	Europe
2006	Sikka, S. – Livestock Research for Rural Development	Effect of oncorporating biogas slurry (BGS) on the growth performance and carcass traits of growing pigs	India

Year	Author / Editor	Title	Country / web site
2006	SOGEAO – Sociéte de la gestion d'Abattoir Ouagadougou – Direction Générale / Direction Téchnique	Le Biogaz	Burkina Faso
2006	Stadtwerke Schwaebisch Hall GmbH	Kraftstoffvergleich	Germany
2006	Unknown author	Why are solar cookers still unpopular among development experts?	Burkina Faso
2006	Yapp, J. – APCAEM	Agricultural Engineering in Support of the Kyoto Protocol – The Clean Development Mechanism for Biogas Technology	China
2005	AFPRO-CHF Network Programme	Biogas – The Indian NGO Experience	India
2005	CILSS	Stratégie énergie domestique du Burkina faso	Burkina Faso
2005	CIPAV, CelAgrid, UTA Cambodia	The optimization of gas production in tubular plastic biodigesters by charging with different proportions of pig and cattle manure	Cambodia
2005	CREPA	ECOSAN Info ; Nr. 1 ; 2 ; 3	Burkina Faso / www.resaucrepa.org
2005	ESMAP	Energy Security Concept Note – Draft	Africa
2005	FAO Corporate Document Repository	Mixed crop-livestock farming	International www.fao.org/docrep/004/Y0501E/y0501e07.htm
2005	FEWS NET	Burkina Faso Monthly Food Security Update, February 2005	Burkina Faso
2005	Hamadou, S. et al – CIRDES & MRA	Diagnostic de la filière lait au Burkina Faso	Burkina Faso
2005	Hu Q.	The Promotion of Rural Domestic Biogas Plants in P.R. China	China
2005	Kraemer, P.	Emissionsersparnisse und mögliche CO2-Gutschriften durch den Einsatz von Solarkochern in Tschadischen Familien	Chad
2005	Laaber, M. et al	Development of an evaluation system for Biogas plants	
2005	Les Editions J.A.	Atlas de l'Afrique : Burkina Faso	France
2005	Partners for Africa & EU Commission	Policy Dialogue Senegal	Senegal

Year	Author / Editor	Title	Country / web site
2005	Sanga, G.A.	Evaluation of the economic impacts of efficient stoves and cooking fuel substitution for urban households in Dar es Salaam, Tanzania	Tanzania
2005	Traoré, I.	Towards sunny solutions in Burkina Faso – Development Studies Centre Kimmage Manor	Burkina Faso
2005	UEMOA	Input 2005 – Situation Energétique de l'Union	West Africa
2005	United Nations Secretary-General	UN Millennium Development Goals	www.un.org/millenniumgoals
2005	Wikan, W.T. et al	Development of Biogas Processing for Small Scale Cattle Farm in Indonesia	Indonesia
2005	Wong Meng Lei, Institute for Community Education	A handbook of Biogas	Malaysia
2005	Yager, A. UNDP	The Roel of Cleaner Fuels in Poverty Reduction	International
2005	Yaméogo, G – CEDEAO & PNUD	Monographie du pays élaborée dans le cadre de la politique régionale pour « l'accroissement de l'accès aux services énergétiques des populations rurales et periurbaines pour atteindre les objectifs du millénaire pour le développement »	Burkina Faso
2005	Zhenqing Sun et al	Feasibility Study if Biogas Property Management Service System in China	China
2004	Archiv fuer Kunst und Geschichte	Kochkunst am offenen Kuechenherd vor 500 Jahren – Vortrag Holzverbrennung Grundlagen	Germany
2004	Cornell University: Manure Management Program	Feasibility Study of Fuel Cells for Biogas Energy Conversion on Large Dairy Farms	United Kingdom
2004	Institut Géographique du Burkina (IGB)	Plan du Ville de Ouagadougou Burkina Faso – Carte touristique et routière	Burkina Faso / www.igb.bf
2004	Kuijpers, H – Open Universideid Nederland	Potential of Biogas Technology in Developing Countries	The Netherlands
2004	Ministère de l'Economie et du Développement	Deuxième enquête nationale sur les effectifs de cheptel : résultats et analyses	Burkina Faso

Year	Author / Editor	Title	Country / web site
2004	Ministère de l'Economie et du Développement	Monographie de la province de la Gnagna Monographie de la province du Gourma Analyse de la dynamique socio-économique de la région de l'Est Burkina Faso – Cadre Stratégique de Lutte contre la Pauvreté	Burkina Faso
2004	Ministère des Mines des Carrières et de l'Energie Direction des Énergies Renouvelables et Traditionnelles	Stratégie Nationale de la Filière Bois-Energie. Programme d'actions 2005-2010	Burkina Faso
2004	Petschel-Held, G. et al WBGU	Welt im Wandel: Armutsbekämpfung durch Umweltpolitik: Armut und Umwelt in Burkina Faso und NO-Brasilien: Entwicklung und Anwendung eines Matrixkonzepts zur Beschreibung differenzieller Vulnerabilitaeten gegenueber dem globalen Wandel	Germany
2004	Thorne, P. – Participatory Livestock Development Project CIAT, ILRI	Pig Raising in Northern Lao PDR, Working Paper No. 4	Lao PDR
2003	All India Co-Ordinated Research Project on Renewable Sources of Energy, Central Institute of Agricultural Engineering	Fixed Dome Biogas Plants for Solid-Stat Digestion of Cattle Dung	India
2002	Department for Environment, Food and Rural Affairs, UK	In-depth review of the outputs of DEFRA's programme of research on the measurement and control of ammonia emissions from agriculture (1998-2002)	Europe
2003	Drangert, J.-O. Et al.	Use and abuse of the urban groundwater resource: implications for a new management strategy	Published online: Hydrogeology Journal 2004
2003	Krämer, P.	Wood Fuel Scarcity in the Sahel and the Potential of Solar Cookers	Chad
2003	Ministry of Agriculture, Food and Rural Affairs	A Review of Selected Jurisdictions and Their Approach to Regulating Intensive Farming Operations	Canada

Year	Author / Editor	Title	Country / web site
2003	Ministère de l'Economie et du Développement	Monographie des activités socio-économique et des micro-entreprises rurales dans la région de l'est Cadre stratégique régional de lutte contre la pauvreté	Burkina Faso
2003	Persson, M. – School of Environmental Engineering	Evaluation of upgrading techniques for biogas	Sweden
2001	ADB TA 3370-PRC	Efficient Utilization of Agricultural Wastes Project – Financial and Economic Analyses for Case Study in Jiangxi Province: Xinfeng Pig-Biogas-Citrus Model	China
2001	Coopération Burkina – Danoise	Etude sur la filière commercial du bois–énergie au Burkina Faso	Burkina Faso
2001	DANIDA – LFG consult	Field Review Report for Biogas Experience in Egypt, 3 Volumes	Egypt & Denmark
2001	FAO	Global Farming Systems Study: Challenges and Priorities to 2030: Regional Analysis – Sub-Saharan Africa	International
2001	MAHRH/PAGIRE	Etat des lieux des ressources en eaux au Burkina Faso et de leur cadre de gestion	Burkina Faso
2001	Ministère de l'Economie et des Finances	Conseil National de la Planification Stratégique – Etude National Prospective « Burkina 2025 » - Etude rétrospective macro-économique du Burkina Faso	Burkina Faso
2000	Kabore, C. – Commission Européenne Direction Générale VIII Développement	Revue et amélioration des données relatives aux produits forestiers au Burkina Faso	Burkina Faso
2000	Ministère de l'économie et des finances	Politique national de Population du Burkina Faso	Burkina Faso
1999	F.B.T.R.D.	Les utilisations des moyens intermédiaires de transport au Burkina Faso	Burkina Faso
1998	Eng-Leong Foo et al.	Integrated Bio-Systems in Zero Emissions Applications – the potential of integrated bio-systems in Small Pacific Island Countries	Western Samoa www.ias.unu.edu/proceedings/icibs
1998	IRSAT	Synthèses des expériences de la filière Biogaz/compost au Burkina Faso	Burkina Faso

Year	Author / Editor	Title	Country / web site
1997	Programme Energie Domestique Sahel, Kiessling, J. et al	Etude sur le développement dans le secteur de production et de vulgarisation des foyers améliorés et d'autres technologies a Bobo-Dioulasso, Burkina Faso	Burkina Faso
1997	Programme Energie Domestique Sahel, Sawadogo A.	Atelier sur la rôle de la femme dans le développement énergétique durable / Etude sur le développement dans le secteur de production et de vulgarisation des foyers améliorés et d'autres technologies a Ouagadougou et Bobo-Dioulasso, Burkina Faso	Burkina Faso
1996	Consolidated Management Services Nepal Ltd & FAO	Biogas Technology – a training manual for extension	Nepal
1996	C.D.E.R. Service Biomasse et Environnement	Guide de construction et d'utilisation des installations biogaz	Morocco
1996	FAO	Livestock & the Environment – Finding a Balance	International
1994	Stratégie Energie Environnement Développement	Programme Régional Gaz Nutane dans les Pays du CILSS – Evaluation Finale – Rapport Final	France
1994	Tata Energy Research Institute TERI	Construction of Biogas Plants – a manual	India
1993	CCE	Evaluation finale Programme Régionale de Gaz	Belgium
1993	GTZ & BORDA	Critères pour la Diffusion d'Installations de Biogaz pour les systèmes d'Exploitations Agricoles et Ménagers Criteria for the Dissemination of Biogas Plants for Agricultural Farm and Household Systems	Germany
1992	Convenio Colombo Aleman CVC-GTZ-Biosystem	Biodigestores cupula fija – guía de construcción	Colombia
1991	Biogas Extension Service CAMARTEC	The CAMARTEC biogas unit – a user's manual	Tanzania
1991	BioSystem GmbH & GTZ	Bio_Calc Computer prgramm for the calculation of simple agricultural biogas plants	Germany
1991	ORMVA Souss-Massa & gate	Le biogas dans la region du Souss-Massa	Morocco
1991	Sasse, L. (BORDA) & LPTP	The Bio-digester at the hills of Central Java	Germany & Indonesia

Year	Author / Editor	Title	Country / web site
1990	BMZ, GTZ, BORDA & Ministry of Energy, DNES, UNDARP	International Conference on Biogas – technologies and implementation strategies – final recommendations	India
1989	CAMARTEC & gate	CAMARTEC Arusha, Tanzania – example of the Biogas Extension Programme of gate/gtz	Tanzania
1989	Projet Biogaz Cankuzo & gate	Installation de Biogaz Kigamba II au Burundi	Burundi
1989	Werner, U et al – gate / gtz	Biogas Plants in Animal Husbandry – a practical guide	Germany
1988	Oelert, G. Et al – gtz Sonderpublikation No. 185	Economic Issues of renewable Energy Systems	Germany
1988	Sasse, L. & gate / gtz	Biogas Plants	Germany
1987	ESMAP & WB	Joint UNDP & WORLD BANK Energy Sector Management Assistance Programme	U.S.A.
1986	Projet Biogaz Cankuzo & gate	Biogas Plant Bweru Farm in Burundi	Burundi
1986	Seyoum, S – Livestock Division ILCA	The economics of a biogas digestor	Ethiopia
1986	Werner, U. Et al – gtz Sonderpublikation Nr. 180	Praktischer Leitfaden für Biogasanlagen in der Tierproduktion	Germany
1985	Eggeling, G. et al – BORDA & gtz	Biogaz – Installations Communautaires – Manuel	Germany
1985	Fick, H. Et al – gtz Schriftenreihe No. 163	A guide to the financial ecaluation of investment projects in energy supply	Germany
1985	Hohlfeld, J. – gtz Schriftenreihe No. 97	Production and Utilization of Biogas in Rural Areas of Industrialized and Developing Countries	Germany
1984	The Energy Education Unit, Ministry of Mining & Energy	Do-it-yourself Chinese Model Biogas Plant	Jamaica
1984	State Bureau of Standardization	The National Standard of the People's Republic of China – GB 4750-4752-84	China
1983	Auteur inconnu	Utilisation du biogaz en Haute-Volta	Burkina Faso
1983	Auteur inconnu	Technologie de la fermentation méthanique : génie des fermenteurs	Belgium
1983	Comité Interafricain d'études hydrauliques	La Filière biogaz-compost en Haute-Volta / Les travaux et réalisations du CIEH	Burkina Faso

Year	Author / Editor	Title	Country / web site
1983	Gtz-gate: Hees, N. Et al.	Documentation sur l'installation de biogaz de Pabré / Haute Volta	Burkina Faso
1983	Traoré, S.	Aspects théoriques de la fermentation méthanique : étapes et paramètres du processus	Burkina Faso
1982	Institut Voltaïque de l'Energie	Le Biogaz	Burkina Faso
1981	Chome, R.	Expérience de digesteurs en site réel en Europe et en Afrique	Belgium
1981	Keita, J.D. -FAO	Wood or charcoal – which is better ?	Ghana / Burkina Faso
1980	Stier, E et al – ATV	Klaerwaerter-Taschenbuch	Germany
1980	Chauvin, H. - UNASYLVA & FAO	Une ville d'Afrique à court de combustible	Burkina Faso
1977	CIEH & IRAT : Station de recherches agronomique de Saria	Expérimentation des moyens de production de compost enrichi et d'énergie en milieu rural	Burkina Faso
1956	Roediger, H.	Die anaerobe Schlammfaulung	Germany

Annex 13: Terms of References

Terms of Reference "Biogas for a Better Life": Feasibility study for national domestic biogas program in Burkina Faso

6 Introduction and background

The following presents the Terms of Reference (ToR) prepared by GTZ for a detailed study analysing the technical, economic, and socio-political feasibility of initiating a large-scale household biogas program including resource recovering sanitation systems in **Burkina Faso.**

The work will draw from GTZ's International experience with (1) economic development and capacity building in rural Africa, (2) dissemination of a range of renewable energy systems, improved cook stoves, and resource recovering sanitation systems in rural areas around the world, (3) experiences made with the design and implementation of small biogas projects under the past biogas dissemination projects in Africa, (4) the establishment of micro credit facilities in rural communities in developing countries, (5) valuation of social, agricultural and environmental benefits.

7 Objective of the study

The objective of the study is to thoroughly assess the feasibility to set-up and implement a national biogas programmes to meet energy, sanitation, health, environment and income needs.

More specifically, the study will address the following areas:

7.1 Provide country background, including

- assessment of poverty incidence and rate in rural areas,
- development status in the agricultural and livestock sectors,
- common livestock farming practices, geographical distribution of livestock farming
- energy demand and supply in the household sector; energy policy and plans
- fertiliser demand, common practises of fertiliser use based on animal manure and/or human excreta, policies and plans
- health, nutrition and sanitation needs; experiences with resource recovery by means of ecological sanitation systems; policies and plans,
- local environmental concerns such as deforestation and decreasing water quality and other resources
- political stability
- existing institutional set-up relevant for a possible national biogas programme

7.2 Describe the history of biogas in the respective countries including a synopsis of lessons learned

7.3 Assess the overall feasibility of a market oriented domestic biogas program

7.3.1 Technical feasibility

- technical description of the appropriate biogas plant with attached optimised sanitation facilities and recyclates collection
- key components/materials to be used for construction of biogas plants and connected buildings such as stables and toilets
- quality parameters for the biogas plant components and methods to test the quality
- necessary household appliances for gas and slurry use in agriculture and gardening
- operation and maintenance requirements (type of available and potential feedstock, equipment and tools needed for feedstock preparation, comfortable feed-in process, and slurry

use, minimum amount of feedstock for feasible operation)
- technical, construction and operation risks (leakages, effect of pesticide and drug residues)

7.3.2 **financial and economic feasibility**
- capital requirements of biogas plant constructors
- production costs
- delivering costs
- service costs
- cash flow of biogas plant constructors
- break-even analysis
- business development requirements
- critical risk factors

7.3.3 **market viability**
- target customer (number and type of livestock, animal husbandry system, use of stables, access to water, sanitation practices, manure and excreta management, veterinary practices, income level, gender, educational level, cooking and lighting practices, expenditures for firewood and other fuels, purchasing behaviour)
- targeted geographic area (number of target customers, availability of firewood, water, climatic conditions, political stability, safety situation)
- estimated market size
- expected sales levels for 10 years
- costumers needs to be addressed by biogas
- benefit of biogas for the customer
- competing products (e.g. improved cook stoves, chemical fertiliser, conventional sanitation system)
- advantage of biogas system in comparison to competing products
- level of actual market demand
- planned marketing and sales strategy (pricing strategy, intended payment terms, warranty, distribution/selling system, expected profit margins)
- critical market risk factors

7.3.4 **social and political feasibility**
- knowledge on and experiences with biogas technology
- socio cultural acceptance of biogas for cooking purposes
- socio cultural acceptance of the attachment of toilets;
- socio cultural acceptance of sludge reuse if based on human faeces
- socio cultural acceptance of potential changes in daily work procedures and load
- socio cultural acceptance of potential changes in use of animal manure
- relevant government regulations in the water, sanitation, fertilizer agriculture and health sector which have to be complied

7.4 Evaluate existing national programs and goals for sanitation and health, improved livelihoods and environment and estimate the economic value of expected benefits from the introduction of household biogas systems with associated improved sanitation and health programs where applicable.

7.5 Evaluate existing institutions and enterprises of the formal and informal sector including those that could provide:
- construction and maintenance of biogas plants and all attached systems and appliances including after sales services
- quality control
- micro-finance
- dissemination of health and sanitation information
- training for entrepreneurs
- manufacture of systems and appliances, maintenance and operation
- management of household level financial incentives
- marketing and promotion

- agricultural extension for sustainable livelihoods programs
- partnerships with ongoing programs, including those involving dairy improvement, zero-grazing movement and fodder production, vegetable production and nutrition improvement, sanitation, water, health and hygiene.
- monitoring and evaluation
- overall coordination

7.6 Evaluate appropriate subsidy schemes based on projected benefits and mechanisms for management of subsidies

7.7 Evaluate possible system for quality assurance of biogas plants and attached systems and appliances

7.8 Prepare outline for a national biogas, sanitation and hygiene implementation plan

including
- intended objective, output, activities,
- indicators and milestones
- time schedule
- institutional set up
- role of GTZ, management structure
- role of other development agencies
- risks and assumptions
- budget, needed funding (how much and when)
- expected contributions

8 Activities and methodologies

The following key activities and methodologies should be carried out:

- desk study to collect additional information regarding points 2.1., 2.2 and 2.3:
    - Literature research via internet
    - Refining terms of reference in coordination with team leader and Tanzania consultant team
    - Checklists for biogas plant visits and interviews to institutional key informants in Burkina Faso
    - Joint development of a common questionnaire for household surveys, with Tanzania consultant team, and translation in French
- On-site mission by international experts to collect additional information regarding points 2.1., 2.2 and 2.3 and study relevant information for 2.4 – 2.8: This will include following activities :
    - Meetings and interviews to key informants in Ouagadougou and the selected regions Gaoua and Fada N'Gourma about history and potential of biogas technology, including government officials, research and training institutes, private sector, and NGOs working in energy, livestock agriculture, enterprise development, sanitation and health fields
    - Visit and interviews to practitioners, implementers, potential beneficiaries, donors and government officials involved in past domestic biogas projects to fully understand historical successes and failures (comparing best available examples with malfunction examples);
    - Household survey in the 2 regions of Gaoua and Fada N'Gourma: Interviews to potential beneficiaries (up to 50 families in each region) to assess their needs and acceptance of biogas plants with or without attached toilet;
    - Market study on construction prices, fertilizer, water and livestock value
    - Analysis of statistical data: health, income, development figures and plans.
- Organizing and facilitating a workshop on findings with about 25 selected stakeholders in Burkina Faso by end April 2007

- Formulation of a draft study report and submission for comments to GTZ study group (leaded by Mr. Carsten Hellpap) until May 7th 2007
- Submission of the final study report incorporating the reviewer comments, and recommendations for a 10-year national biogas programme implementation plan until May 31st 2007

9 Time schedule

The feasibility study (desk study and field mission) shall be completed by the beginning of May, 2007. The draft report shall be submitted by 7th of May, 2007 for comments. The final draft shall be presented the 20th of May, 2007, and the final report by the end of May, 2007.

The overall study duration is about 42 days over the period from 12.03.2007 to 31.05.2007 (according to the work plan below):

- up to 21 days for desk work and report elaboration
- 21 days for the field mission in Burkina Faso

Periods	Activities
12.03. - 06.03.2007	Desk study, Mission preparation in collaboration with GTZ office in Ouagadougou, Development of a table of content for the report and of a common questionnaire for household survey, in close collaboration with the Tanzania Study team
10.04. - 30.04.2007	Field work (Mission) in Burkina Faso, according the point 3 ***"Activities and methodologies"*** in the Terms of Reference
01.05. - 07.05.2007	Elaboration and submission to GTZ of the 1st Report draft for comments and review
14.05. - 20.05.2007	Writing of the Final Draft of the Report and submission to GTZ
22.05. - 23.05.2007	Final Conference in Nairobi
24.05. - 31.05.2007	Submission of the Final Report, including all comments

10 Composition of the team

The study team should include international and local experts with skill sets, such as:

- **Team Leader** (*Mr. Heinz-Peter MANG*). As biogas key expert, he will be the overall mission and report elaboration coordinator. Thus, he will take the overall responsibilty of the report content and the finalisation of the study, and he is the key contact for national authorities (from ministries, institutions, communes, etc.).

  Other specific tasks will be: Check list of contacts; Institution and site visits; Data analysis and evaluation; Workshop co-moderation. With regard to report writing, he is responsible for the points 2.2 to 2.8, particularly the financial and economic feasibilty, the market viability, and social and political feasibility.
  Total work days: up to 30 (including 21 in Burkina)

- **Socio-economist** (*Mrs. Elisabeth HUBA* from *FRUXOTIC International Consultancy*) as expert for valuation of multiple development benefits. She will be responsible for the development and the realisation of household surveys and for the logistic.

  Other specific tasks will be: Institution and site visits; Interviews, Data analysis and evaluation, Workshop organisation and co-moderation, Training for local students or assistants for household surveys; Consultation with the Tanzania Studie Team, especially with regard to the questionnaire for household surveys. Regarding the report writing, she is responsible for the points 2.3 to 2.6.
  Total work days: up to 30 (including 21 in Burkina)
  FRUXOTIC International Consultancy will also assume the responsibity for (i) the overall study logistic, (ii) the organisation of the workshop on "Mission Findings", and (iii) all local subcontracts for local experts and assistants.

- **Biogas and eco-sanitation specialist** (*Mr. P. Abdoulaye Fall*) as expert for household biogas and domestic waste treatment familiar with the context in West Africa. He will be responsible for the desk study, communication and information coordination and management, and the overall preparation of the mission.

  Other specific tasks will be: Elaboration of the contact list, in accordance with the Team leader and GTZ office in Ouagadougou; Meeting, visit and interviews planning, in close in collaboration with the GTZ Office in Ouagadougou; Research institution and site visits / interviews, Internet search, Translation of relevant documents; Consultation with the Tanzania team. With regard to report writing, he is responsible for the points 2.1 to 2.2 and the French summary, and will support the team leader in points 2.4, 2.6-2.8.

  Total work days: up to 42 (including 21 in Burkina)

- **Water and sanitation expert** (*Mr. Patrick Bracken)* familiar with the context in Burkina Faso. As key informant, he will provide support in terms of identifying key actors, planning and organising meetings and interviews. He will also provide inputs and advices for the report writing and act as report reviewer.

  Total work days: up to 5

- **Up to 2 local technical experts** *(including Mr. Gombila KABORE)* as key informants on household biogas systems and rural household dynamics in Burkina Faso including agriculture, health, nutrition, sanitation and hygiene aspects, and appropriate capacity building.

  They will provide support in terms of identifying key actors, planning and organising meetings/workshops, site visits and interviews, and household surveys. They will also provide inputs and advices for the report writing, and act as report reviewers.

  Total work days: up to 10 for each

- Up to **4 local students/assistants** (*have to be identified and selected on-site*), who will carry out the household surveys, and will be in charge of information gathering and eventually local language translation. They may participate in survey analysis.

  Total work days: up to 5 in Burkina for each

11 Expected output

The report on the feasibility study shall be well-structured and clearly written in English and provide informed recommendations on the possibilities to set-up a national programme on domestic biogas in Burkina Faso. It will take into the line the positive points as well as the weakness of the feasibility reports Rwanda and Ethiopia, already produced and published. The structure and the content of the study will be coordinated with the feasibility study in Tanzania.

The final report will be available in hard copy (5 exemplars) and electronic forms.

11.1 Annex 14 : Questionnair for Rapid Household Survey 2007

11.2 QUESTIONNAIRE DE MENAGES – INFORMATION DE BASE

pour évaluer le potentiel pour la mise en œuvre de la technologie de biogaz

Nom de l'enquêteur:

…….

Date de l'enquête: …………………………………………………………………………………………….

Date d'entrée de données: ……………………………………………………………………………………

1. Ménage et ses membres

Nr.	Question	Réponse	Code
1.1	Code d'échantillon pour le ménage choisi		
1.2	Pays		
1.3	Province		
1.4	District		
1.5	Commune		
1.6	Village		
1.7	Nom et sexe du chef de famille		**F (1) M (2)**

<table>
<tr><td>1.8</td><td colspan="3">Nom et sexe du membre du ménage interviewé</td><td colspan="2"></td><td>F (1) M (2)</td></tr>
<tr><td>1.9</td><td colspan="3">Nombre et sexe des membres du ménage</td><td colspan="2">Femme: …….</td><td>Homme: ……</td></tr>
<tr><td>1.10</td><td colspan="2">Âge des membres du ménage</td><td colspan="2">de....... à.....</td><td colspan="2">de...... à.......</td></tr>
<tr><td>1.11</td><td colspan="3">Combien de générations vivent dans le ménage?</td><td colspan="3"></td></tr>
<tr><td rowspan="3">1.12</td><td colspan="6">Enseignement formel: sait écrire et lire (1), primaire (2), secondaire (3), centre technique/professionnel (4), université (5) - note pour le mari et épouse séparément, pour des fils / des filles comme 1+ 4</td></tr>
<tr><td>chef de famille</td><td></td><td>Époux / épouse</td><td></td><td>fils</td><td></td></tr>
<tr><td>filles</td><td></td><td colspan="3">D'autres membres de famille vivant dans le ménage</td><td></td></tr>
<tr><td rowspan="2">1.13</td><td colspan="6">Formation extra-ordinaire: la participation aux cours de formation conduits par des ONGs, services gouvernementaux, églises... - note autant que la personne entrevue se rappelle, et QUI a participé: mari (1), épouse (2), fils (3), fille (4), d'autre membre de famille (5), ouvrier (6)</td></tr>
<tr><td colspan="5">Sujet …..</td><td>Participant/e</td></tr>
</table>

2. Système de production animale et gestion du troupeau

2	espèces animales	but	nombre	Système de production animale / gestion du troupeau							
				Stabulation permanente (1)	Stabulation saisonnière (2)	Stabulation durant la nuit (3)	Pâturage contrôlé (4)	Pâturage non contrôlé (5)	Migration saisonnière	Propriété de la famille	Preneur de soin / responsable:
				Construction d'étable: bâtiment fermé avec le plancher en béton (1), murs, toit, plancher en béton (2), abri couvert avec le plancher en béton (3), abri couvert avec le plancher en boue (4), corral (5), autre (6 - décrivez SVP) *SVP note par exemple: stabulation permanente et l'étable (1) note 1/1; stabulation saisonnière et le corral: note 2/5*					Oui (1) Non (2)	Oui (1) Non (2)	mari (1), épouse (2), fils (3), fille (4), d'autre membre de famille (5), ouvrier (6) *SVP note par exemple: 2+3+5)*
2.1	Bétail	Laiterie									
2.2	Bétail	Viande									
2.3	Bétail	Traction									
2.4	Moutons	Laiterie									
2.5	Moutons	Viande									
2.6	Chèvre	Laiterie									
2.7	Chèvre	Viande									
2.8	Porc										
2.9	Cheval										
2.10	Poulet										
2.11	Canard										
2.12	Lapins										
2.13	Autres										

3. Système agricole – 6 produits principaux

3	Produit agricole	Production totale par an (SVP note unité récoltée en kg)	Surface cultivée (SVP note unité)	But (famille = propre consommation) (identifier par X tout ce qui s'applique)	Taux de production (%)	Système de production							
						Champ de la Communauté (1)	Champ privé (2)	Jardin familial (3)	Utilisation d'engrais - *veuillez donner les coûts/an*				Irrigation (8)
									engrais chimique (4)	compost (5)	Fumier animal (6)	excréta aseptisés (7)	Oui (1) Non (2)
3.1	Céréales: sorgho, millet, riz, blé, maïs...			Famille									
				Marché									
3.2	Tubercule: igname, manioc, patate douce, pomme de terre …			Famille									
				Marché									
3.3	Légumes			Famille									
				Marché									
3.4	Fruits			Famille									
				Marché									
3.5	Culture à commercialiser			Famille									
				Marché									
3.6	Fourrage animal			Famille									
				Marché									
3.7	Plantes énergétiques			Famille									
				Marché									

4. Ressources naturelles locales dans le village et ses environs, et problèmes environnementaux

4	Ressource naturelle	Distance de la maison (notez SVP tous les deux: km et temps total passés)		Disponibilité						
				Constamment disponible Oui (1) Non (2)	Saisonnière ment disponible (de.... à....)	Paiement pour l'usage		Sous contrôle gouvernement al Oui (1) Non (2)	Propriété privée	
						Oui (1) Comptant (11) - combien? En nature (12) comment?	Non (2)		De la famille	D'autres
4.1	Eau	km								
		heures								
	Problème?									
4.2	Forêt	km								
		heures								
	Problème?									
4.3	Pâturage naturel	km								
		heures								
	Problème?									
4.4	Animaux sauvages	km								
		heures								
	Problème?									
4.5	Autres (notez SVP)	km								
		heures								
	Problème?									

11.3

5. Approvisionnement en énergie et utilisation de l'énergie

5	Ressource d'énergie	But cuisson (1), éclairage (2), agriculture (3), atelier (4), transport (5), divertissement (6) autre (7) - *notez tout SVP*	Distance de la maison pour l'achat Km ou h *notez SVP l'unité*		Quantité utilisée par mois	Possédé (1) et opéré (2) par			Disponibilité				
						Famille (1)	Public (2)	Privé *Autre que la famille* (3)	Permanente (1) Oui (1) Non (2)	Saisonnière (2) h/j ou mois/an (de … à …)	Problèmes?	Paiement pour l'usage	
												Oui (1) - combien p/ mois?	Non (2)
5.1	Bois du feu												
5.2	Charbon												
5.3	Fumier sec												
5.4	Gaz en bouteille												
5.5	Kérosène												
5.6	Batterie de Voiture												
5.7	Batteries												
5.8	Bougies												
5.9	Electricité												
5.10	Solaire												
5.11	Éolienne												
5.12	Biogaz												
5.13	Autres												
5.13	Les 3 sources d'énergie les plus importantes pour votre famille						1.			2.	3.		
5.14	L'approvisionnement en énergie pour cuisiner (1)/éclairage (2)/autre (3) - *indiquez SVP* – est					Moins qu'assez pour le besoin de la famille			1	Juste assez pour le besoin de la famille			2
						Plus qu'assez pour le besoin de la famille			3	Je ne sais pas			4
	Pourquoi?												

6. Infrastructure locale, qualifications techniques et disponibilité de matériaux de construction

Nr.	**artisans et ateliers**	**Distance à l'endroit - notez SVP l'unité (kilomètre ou heures)**		**unité à payer**	**prix/unité** Comptant (11) combien? En nature(12) – comment?
6.1	Maçon				
6.2	Charpentier				
6.3	Forgeron				
6.4	Plombier				
6.5	entreprise de construction				
6.6	Production de brique				
6.7	Production de bois de construction				
6.8	Production de métal ouvré				
6.9	Réparation de voiture				
6.10	autres ateliers de réparation				
6.11	autres ateliers de construction				
	Matériaux de construction				
6.12	Briques				
6.13	Ciment				
6.14	Bois de construction				
6.15	Matériel de tuyauterie				
6.16	Matériel de garnitures sanitaires				
	Infrastructure locale *(si plusieurs magasins/services de la même sorte, SVP donne le nombre)*				
6.17	Magasin de nourriture				
6.18	Magasin non-alimentaire				
6.19	Boulangerie				
6.20	Boucher				
6.21	Coopérative agricole				
6.22	Coopérative Villageoise de Crédit				
6.23	Banque				
6.24	École Primaire				
6.25	École secondaire				
6.26	Églises				
6.27	Service de santé				

6.28	Le service dans le village est	Moins qu'assez pour le besoin de la famille	1	Juste assez pour le besoin de la famille	2
		Plus qu'assez pour le besoin de la famille	3	Je ne sais pas	4
	Pourquoi?				

11.4

7. L'économie de la famille – (SVP notez s'il y a des variations pendant l'année!)

Nr.	**activités génératrices de revenu**	**Responsable:** mari (1) / épouse (2) / fils (3) / fille (4) / d'autre membre de famille (5) - *SVP notez tout : par ex. : 2 + 3 + 5*	**Prix du marché/unité** comptant (11) en nature (12)	**Revenu par mois**
7.1	**Production animale**			
7.1.1	Vaches Laitières			
7.1.2	Bœufs/vaches Viande			
7.1.3	Bœufs/vaches Traction			
7.1.4	Brebis Laitières			
7.1.5	Mouton Viande			
7.1.6	Chèvre Laitière			
7.1.7	Chèvre Viande			
7.1.8	Porc			
7.1.9	Cheval			
7.1.10	Poulet			
7.1.11	Canard			
7.1.12	Lapins			

Nr.	activités génératrices de revenu	Responsable: mari (1) / épouse (2) / fils (3) / fille (4) / d'autre membre de famille (5) - SVP notez tout : par ex. : 2 + 3 + 5		Revenu par mois
7.1.13	Autres *(notez SVP)*			
7.2	**Agriculture**			
7.2.1	Céréales			
7.2.2	Tubercule			
7.2.3	Légumes			
7.2.4	Fruits			
7.2.5	Cultures à commercialiser			
7.2.6	Fourrage animal			
7.2.7	Autres *(notez SVP)*			
7.3	**Artisanats et ateliers**			
7.3.1	Maçonnerie			
7.3.2	Charpentier			
7.3.3	Plombier			
7.3.4	réparation des voitures ou des bicyclettes			
7.3.5	Tailleur			
7.3.6	Boulangerie			
7.3.7	Moulin (riz et d'autres)			
7.3.8	Artisanats			
7.3.9	Autres *(notez SVP)*			
7.4	**Emploi**			
7.4.1	Administration d'état			
7.4.2	Professeur			
7.4.3	ONG			
7.4.5	Entreprise privée de production			
7.4.6	Entreprise privée de service (par exemple service de transport)			
7.4.7	Ménage Privé			
7.4.8	Entreprise de Village (coopérative)			
7.4.9	Église			
7.5	**Commerce**			
7.5.1	kiosque			
7.5.2	Magasin			
7.5.3	Vente de produits agricoles			
7.5.4	Culture à commercialiser			
7.5.5	Vente de produits animaux			
7.5.6	Vente de bétail / animaux			
7.6	**Pensions et subventions gouvernementales**			
7.7	**Prêts et crédits**			

7.7.1	Est-ce que quelqu'un dans votre famille a déjà reçu un prêt ou un crédit?	Oui (1)	Non (2)	Qui?	Quand?

7.7.2	Argent requis pour: *(indiquez tout ce qui s'applique:√)*	Santé	Éducation	Machines et outils	véhicules	Profession
		Voiture	Animaux	Agriculture	Maison	Amélioration générale

7.7.3	De quel établissement	groupe villageois (1)	Coopérative (2)	Banque (3)	Église (4)	Projet (5)	Famille (6)	Amis (7)

7.7.4	Période de remboursement	Moins de 6 mois	Entre 6 mois et 1 an	1 à 2 ans	2 à 5 ans	Plus de 5 ans	Pas encore remboursé

7.7.5	Somme reçue			
7.8	**L'épargne**			
7.8.1	La famille a-t-elle un compte d'épargne?	Oui (1)	Non (2)	Qui?

7.8.2	Dans quel établissement ?	group villageois (1)	Coopérative (2)	Banque (3)	Église (4)	Projet (5)	Famille (6)	Amis (7)

7.9	L'argent est	Moins qu'assez pour le besoin de la famille	1	Juste assez pour le besoin de la famille	2
		Plus qu'assez pour le besoin de la famille	3	Je ne sais pas	4

8. La santé

Nr.	**Problèmes de santé**	**Personne affectée:** mari (1) / épouse (2) / fils (3) / fille (4) / autre membre de famille / ménage (5) *(SVP notez tout, par exemple 2 + 3 + 5)*	**Temps Moyen de cette maladie dans la famille**
8.1	Diarrhée		
8.2	Tuberculose		
8.3	Problèmes respiratoire aigu		
8.4	Douleurs légères d'estomac		
8.5	Parasites intestinaux		
8.6	Maladies de la peau		
8.7	Infections de l'œil		
8.8	Pneumonie		
8.9	Malaria/Paludisme		
8.10	Kwashiorkor		
8.11	Varicelle		
8.12	Rougeole		
8.13	Dengue		
8.14	Trachome		
8.15	Autre *(notez SVP)*		

8.16	Ma famille est	Très saine	(1)	Saine avec quelques jours de maladie	(2)
		Très malade	(3)	Je ne sais pas	(4)

9. Situation alimentaire

Nr.	**Nourriture**	**Repas:** petit déjeuner (1), déjeuner (2), dîner (3), pendant la journée (4) *(SVP notez tout, par ex.: 2 + 3)*	**Combien de fois**		**Production familiale** (1) **ou achat** (2)	**Consommé par:** mari (1) / épouse (2) / fils (3) / fille (4) / tous (5) *(SVP notez tout, par ex. : 3 + 4)*	**Quantité par mois** (estimation)
			par semaine?	**par mois ?**			
9.1	Céréales: sorgho, millet, riz, blé, maïs...						
9.2	Tubercule: igname, manioc, patate douce, pomme de terre …						
9.3	Légumes						
9.4	Fruits						
9.5	Produits laitiers						
9.6	Viande (vache)						
9.7	Viande (mouton)						
9.8	Viande (chèvre)						
9.10	Viande (porc)						
9.11	Viande (poulet, canard)						
9.12	Viande (autre: notez)						
9.13	Oeufs						

9.14	Poisson						
9.15	Fruits de mer						
9.16	Autre (notez SVP)						
9.17	Autre (notez SVP)						

9.18	Combien de fois par jour préparez-vous un repas?			De combien de temps avez-vous besoin pour faire la cuisine ?		
9.19	La nourriture est	Moins qu'assez pour le besoin de la famille	1	Juste assez pour le besoin de la famille	2	
		Plus qu'assez pour le besoin de la famille	3	Je ne sais pas	4	
9.20	Changements dans la situation alimentaire au cours de l'année	Oui (1)	Non (2)	Pourquoi?		

10. Logement, approvisionnement en eau, gestion des déchets

Nr.	**Infrastructure de la parcelle** *Veuillez fournir un croquis de la parcelle incluant des distances:* - *à la route accessible par camion* - *entre la maison, l'étable et les champs*	**Matériaux de construction** *(SVP notez tout: 1 + 7 + 12)*	**État de construction comparé avec le standard local:** Bon (1), acceptable (2), pauvre (3) mauvais (4)	**Propriétaire** Famille (1), gouvernement (2), personne privé hors de la famille (3), entreprise (4)	**Responsable pour l'entretien:** mari (1) / épouse (2) / fils (3) / fille (4) / autre (5 – décrivez) *(SVP notez tout, par ex.: 1 + 3)*
10.1	**Maison principale**				
10.1.1	**Nombre de chambres**				
10.1.2	**Murs:** Briques (1), béton (2), bois (3), adobe (4), matériel typique local (5 - indiquez SVP), autre (6 - indiquez SVP)				
10.1.3	**Toiture:** Tuiles (7), tôle ondulée (8), matériel typique local (9 – indiquez SVP), autre (10 – indiquez SVP)				
10.1.4	**Plancher:** Tuiles céramiques (11), béton (12), bois (13), matériel typique local (14 – indiquez SVP), autre (15 – indiquez SVP)				
10.2	**Cuisine: dans la maison**		**Oui (1)**	**Non (2)**	
10.2.1	**Murs:** Briques (1), béton (2), bois (3), adobe (4), matériel typique local (5 - indiquez SVP), autre (6 - indiquez SVP)				
10.2.2	**Toiture:** Tuiles (7), tôle ondulée (8), matériel typique local (9 – indiquez SVP), autre (10 – indiquez SVP)				
10.2.3	**Plancher:** Tuiles céramiques (11), béton (12), bois (13), matériel typique local (14 – indiquez SVP), autre (15 – indiquez SVP)				

10.2.4	**Fourneau** *(au cas où plusieurs énergies et appareils à cuire seraient employés, SVP notez tous et ajoutez %)*	fourneau traditionnel au feu de bois / charbon de bois	*……..%*	*1*
		Fourneau amélioré économique au bois (foyer amélioré)	*……..%*	*2*
		Fourneau à kérosène	*……..%*	*3*
		Fourneau à gaz (moderne)	*……..%*	*4*
		Fourneau électrique	*……..%*	*5*
		Brûleur à biogaz	*……..%*	*6*
		Fourneau typique local *(indiquez SVP)*	*……..%*	*7*
		Poêle cylindrique en fonte	*……..%*	*8*
		Autre	*……..%*	*9*

10.3	**Véhicules possédés par le ménage**	**Nombre**	**Utilisé par:** mari (1) / épouse (2) / fils (3) / fille (4) / autres (5 – indiquez SVP) -*(SVP notez tous, par ex. : 1 + 3)*

10.3.1	bicyclette		
10.3.2	Moto (bicyclette)		
10.3.3	Voiture		
10.3.4	Camion		
10.3.5	Tracteur		
10.3.6	Taxi		
10.4	**Outils de production et machines possédés par le ménage**		
10.4.1	Petits outils pour travail agricole		
10.4.2	Charrue		
10.4.3	Moulin		
10.4.4	Pressoir d'huile		
10.4.5	Equipement pour travailler le bois *(SVP notez: électrique / à pétrole / manuel)*		
10.4.6	Machine à coudre *(SVP notez: électrique / à main / à pied)*		
10.4.7	Autre *(indiquez SVP)*		
10.5	**Equipements/appareils ménagers**		
10.5.1	Réfrigérateur *(SVP notez: électrique /à gaz /à kérosène)*		
10.5.2	Chauffe-eau		
10.5.3	Machine à laver		
10.5.4	Radio		
10.5.5	TV		
10.5.6	DVD / VCD / Cassette		
10.5.7	Téléphone		
10.5.8	Téléphone portable		
10.5.9	PC / (ordinateurs portables)		
10.5.10	Lampe de poche et / ou ampoules		
10.6	Est-ce que vous avez acheté quelques uns de ces produits pendant les 12 mois passés?	Indiquez: 10.3 … 10.4 …. 10.5. ….	Comptant ……… ….. FCFA En nature ……………..…….

10.7	Salle de bains, douche, endroit protégé pour l'hygiène personnelle				Oui (1)	Non (2)
	Si NON: *(SVP marquez √)*	fleuve	lac	Puits de village	Autre *(SVP expliquez)*	
	Distance à la maison	Dans la maison		Dans la cour	….. mètre	…….. minutes

10.8	**Gestion des déchets:**	Déchets de cuisine (1) Oui (1) Non (2)	Autres déchets ménagers (2) Oui (1) Non (2)	Déchets animaux (3) Oui (1) Non (2)
	Compost en jardin familial			
	Décharge sans contrôle			
	Collecte par le service municipal			
	Brûler			
	Engrais aux champs			
	Dans le cas où les déchets des animaux sont traités à part, SVP décrivez :			

10.9	**Approvisionnement en eau et décharge des eaux grises**			
10.9.1	**Source d'eau**		**Utilisée pour:** boire (1), faire la cuisine (2), hygiène personnelle (3), chasse d'eau (4) se baigner (5), nettoyage de vaisselle (6), lavage des habits (7), nettoyage de maison (8), animaux (9), irrigation (10), nettoyage de voiture (11), autre (12) – *svp notez tous, pe: 5 + 8 + 9 + 11*	Quantité (litres) disponible et utilisée par jour
	Eau courante interne	*1*		
	Eau courante externe (cour)	*2*		
	Puits familial (cour)	*3*		
	Eau de pluie	*4*		
	Robinet public sans charge	*5*		

<table>
<tr><td rowspan="5"></td><td>Robinet public avec charge</td><td>6</td><td colspan="3"></td><td></td></tr>
<tr><td>Puits public</td><td>7</td><td colspan="3"></td><td></td></tr>
<tr><td>Fleuve</td><td>8</td><td colspan="3"></td><td></td></tr>
<tr><td>Lac</td><td>9</td><td colspan="3"></td><td></td></tr>
<tr><td>Autre - décrivez SVP</td><td>10</td><td colspan="3"></td><td></td></tr>
<tr><td>10.9.2</td><td colspan="6">Evacuation des eaux grises (toutes eaux usées sauf celles des toilettes)</td></tr>
<tr><td></td><td>1. Fosse septique</td><td>1</td><td colspan="4">Fréquence de vidange? …………Par qui? ....
La bourbe est transportée à ……………Coûts de service? …….
Est-ce que le système correspond à vos besoins et idées?
Oui (1) Non (2) Pourquoi / Pourquoi pas? ………………………….</td></tr>
<tr><td rowspan="4">10.9.2 cont.</td><td>2. Réseau d'égouts conduisant vers une station de traitement d'eaux usées</td><td>2</td><td colspan="4">Coûts de service? ………Que savez-vous du système?
Est-ce que le système correspond à vos besoins et idées?
Oui (1) Non (2)
Pourquoi / Pourquoi pas? ……………………………………………….</td></tr>
<tr><td>3. Juste versé</td><td>3</td><td colspan="4">Versé sur la route / dehors de la parcelle? Oui (1) Non (2)
Pourquoi / Pourquoi pas? …….
A l'intérieur de la cour? Oui (1) Non (2) Pourquoi / Pourquoi pas? ……….</td></tr>
<tr><td>4. Système de canalisation ouverte le long de la route</td><td>4</td><td colspan="4">Où finissent les canaux ouverts ?
Est-ce que le système correspond à vos besoins et idées?
Oui (1) Non (2)
Pourquoi / Pourquoi pas? ……………………………………………….</td></tr>
<tr><td>5. Réutilisation</td><td>5</td><td colspan="4">SVP marquez tout ce que vous appliquez - Jardinage: fleurs, arbustes et arbres (1), jardinage: légumes (2), nettoyage de yard (3), agriculture (4), autre (5 décrivez svp)</td></tr>
<tr><td rowspan="3">10.10</td><td rowspan="2">Situation de logement</td><td>Moins qu'assez pour le besoin de la famille</td><td>1</td><td>Juste assez pour le besoin de la famille</td><td>2</td></tr>
<tr><td>Plus qu'assez pour le besoin de la famille</td><td>3</td><td>Je ne sais pas</td><td>4</td></tr>
<tr><td colspan="5">Pourquoi?</td></tr>
<tr><td rowspan="3">10.11</td><td rowspan="2">Conditions pour faire la cuisine</td><td>Moins qu'assez pour le besoin de la famille</td><td>1</td><td>Juste assez pour le besoin de la famille</td><td>2</td></tr>
<tr><td>Plus qu'assez pour le besoin de la famille</td><td>3</td><td>Je ne sais pas</td><td>4</td></tr>
<tr><td colspan="5">Pourquoi?</td></tr>
<tr><td rowspan="3">10.12</td><td rowspan="2">Approvisionnement en eau</td><td>Moins qu'assez pour le besoin de la famille</td><td>1</td><td>Juste assez pour le besoin de la famille</td><td>2</td></tr>
<tr><td>Plus qu'assez pour le besoin de la famille</td><td>3</td><td>Je ne sais pas</td><td>4</td></tr>
<tr><td colspan="5">Pourquoi?</td></tr>
<tr><td rowspan="3">10.13</td><td rowspan="2">Système d'évacuation des eaux grises et des déchets</td><td>Moins qu'assez pour le besoin de la famille</td><td>1</td><td>Juste assez pour le besoin de la famille</td><td>2</td></tr>
<tr><td>Plus qu'assez pour le besoin de la famille</td><td>3</td><td>Je ne sais pas</td><td>4</td></tr>
<tr><td colspan="5">Pourquoi?</td></tr>
</table>

11. Equipement sanitaire et système de traitement

11.1	**Système de toilettes**	**Construction**			**Distance**			**Êtes-vous content(e) avec la situation actuelle?**		
	(SVP marquez tout ce que vous appliquez : √) Chaise turque(1) Chaise à l'Européenne (2)	**Murs:** Briques (1), béton (2), bois (3), adobe (4), matériel typique local (5 - indiquez SVP), autre (6 - indiquez SVP)	**Toiture:** Tuiles (7), tôle ondulée (8), matériel typique local (9 – indiquez SVP), autre (10 – indiquez SVP)	**Plancher:** Tuiles céramiques (11), béton (12), bois (13), matériel typique local (14 – indiquez SVP), autre (15 – indiquez SVP)	mètres	minutes	intérieur	Oui (1)	Non (2)	Pourquoi / Pourquoi pas?
11.1.1	Pas de toilette ou latrines									
11.1.2	Pit latrines	**Murs**	**toiture**	**plancher**						
11.1.3	Pit Latrines ventilée	**Murs**	**toiture**	**plancher**						
11.1.4	Toilette à faible chasse	**Murs**	**toiture**	**plancher**						
	Eau/vidange	**litre**								
11.1.5	Toilette à chasse	**Murs**	**toiture**	**plancher**						
	Eau/vidange	**litre**								
11.1.6	Toilettes à déshydratation	**Murs**	**toiture**	**plancher**						
	Matériaux de séchage		**quantité**							
11.1.7	Toilette à compost	**Murs**	**toiture**	**plancher**						
	Matériaux de mélange		**quantité**							
11.1.8	Autres (décrivez, SVP)	**Murs**	**toiture**	**plancher**						

11.2	**Système d'assainissement**	**Exécution**	**Opération & Maintenance**	**Êtes-vous content(es) avec la situation actuelle?**

		Superficie	**Description**	**par**	**Payé par:**	**Coûts**	**Responsable**	**Donné par**	**Payé par**	**coûts**	**fréquence**	Oui (1)	Non (2)	Pourquoi / pourquoi pas?
		Gouvernement / Municipalité (1) ONG (2), entreprise privée (3), famille (4), autre (5 – décrivez, SVP), néant (6)												
11. 2.1	Conduits ouverts de drainage													
11. 2.2	Pit latrines													
11. 2.3	Fosse septique													
	Trou perdu													
11. 2.4	Fosse septique à biogaz													
	Matériel d'alimentation													
	Utilisation de gaz													
11. 2.4	Système d'égouts *(SVP décrivez)*													
11. 2.5	Système sec et de compostage													
11. 2.6	Autre *(SVP décrivez)*													

11. 3	**Conditions Générales** *(marquez tout ce qui s'applique: √)*										
11. 3.1	Etat des toilettes	Très bien (1)	Pauvre (2)	Mauvais (3)	Propre (4)	Sale (5)	puant (6)	Pas de porte (7)	Pas de fenêtre (8)	Pas d'eau (9)	Pas d'installation pour laver les mains (10)
11. 3.2	Le système d'assainissement est	Très bien (1)	Pauvre (2)	Mauvais (3)	Propre (4)	Sale (5)	puant (6)	Compliqué (7)	Moderne (8)	Confortable (9)	Trop cher (10)

11. 3.3	Pourriez-vous investir dans un système d'assainissement qui offre confort, hygiène, énergie, engrais c.-à-d. un système biogaz?	Oui (1) Combien?	Comment? Vente des animaux (1) Vente des produits agricoles (2)	Non (2) Pourquoi pas?
11. 3.4	Seriez-vous disposé à investir dans un système d'assainissement qui offre confort, hygiène, énergie, engrais c.-à-d. un système biogaz ?	Oui (1) Combien?	Comment? Vente des animaux (1) Vente des produits agricoles (2)	Non (2) Pourquoi pas?
11. 3.5	Pourriez vous imaginer employer l'énergie produite à partir de déchets humains pour	Faire la cuisine: Oui (1) Non (2) Je ne sais pas (3)	L'éclairage: Oui (1) Non (2) Je ne sais pas (3)	

11. 4	Conditions sanitaires	Moins qu'assez pour le besoin de la famille	1	Juste assez pour le besoin de la famille	2
		Plus qu'assez pour le besoin de la famille	3	Je ne sais pas	4
	Pourquoi?				

11.5 12. Distribution du travail à l'intérieur de la famille

12	Travaux et devoirs	mari: heures/jour	épouse: heures/jour	fils: heures/jour	fille: heures/jour	Autres membres de la famille: heures/jour	ouvriers: heures/jour
12.1	**Élevage**						
12.1.1	bétail (production laitière, viande, traction - *SVP notez)*						
12.1.2	chevaux						
12.1.3	porcs						
12.1.4	Moutons & chèvres						
12.1.5	Poulets						
12.1.6	Transformation des produits animaux						
12.1.7	Autres						
12.2	**Agriculture**						
12.2.1	Céréales						
12.2.2	Tubercules						
12.2.3	Légumes						
12.2.4	Fruits						
12.2.5	Culture à commercialiser						
12.2.6	Fourrage animal						
12.2.7	Transformation des produits agricoles						
12.2.8	Autres						

12 cont.	Travaux et devoirs	mari: heures/jour	épouse: heures/jour	fils: heures/jour	fille: heures/jour	Autres membres de la famille: heures/jour	ouvriers: heures/jour
12.3	**Devoirs domestiques et vie familiale**						
12.3.1	Faire la cuisine						
12.3.2	Nettoyage						
12.3.	Approvisionnement en eau						

3							
12.3.4	Approvisionnement en énergie: bois de chauffage (1), fumier (2), autre (3)						
12.3.5	Achat de nourriture						
12.3.6	Construction & réparation des bâtiments familiaux: maison, étable, toilettes …						
12.3.7	Santé: responsable pour les malades						
12.3.8	Education (décision sur scolarité; éducation des enfants …)						
12.3.9	Représentant de la famille dans la communauté (groupes) *(SVP notez le groupe et la fonction)*						
12.3.10	Qui aime participer aux cours de formation?						
12.4	**Changements**						
12.4.1	Aimeriez-vous changer un/plusieurs de ces devoirs?	Oui (1) *(SVP notez lequel, pourquoi et comment)*					Non (2)
12.4.2	Aimeriez-vous améliorer les conditions de vie de la famille?	Oui (1) *(SVP notez pourquoi et comment)*					Non (2)
12.4.3	Combien veuillez-vous investir dans les améliorations?			Conditions de paiement: comptant (1) en nature (2) crédit (3) travail (4)			
12.4.4	Combien êtes-vous capable investir dans les améliorations ?			Conditions de paiement: comptant (1) en nature (2) crédit (3) travail (4)			
12.4.5	Vous considérez votre famille économiquement	Pauvre (1)		Moyenne (2)	Fortune (3)		Je ne sais pas (4)

Annex 15: Photographs

Households
(Credits E.-M. Huba & H.P. Mang)








Cooking places
(Credits E.-M. Huba & H.P. Mang)






Animals
(Credits E.-M. Huba & H.P. Mang)














Animal husbandry practices and composting pits in Burkina Faso (Crédits: A. Fall)

Agriculture & compost
(Credits E.-M. Huba & H.P. Mang)

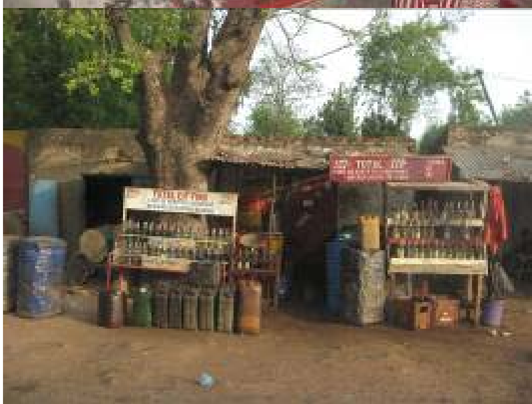






Slaughterhouses & livestock markets
(Credits E.-M. Huba & H.P. Mang)

Energy
(Credits E.-M. Huba & H.P. Mang)



Biogas plants
(Credits E.-M. Huba & H.P. Mang)

Biogas installations visited by the Study Team in Burkina Faso (Crédits: A. Fall)

Sanitation & water
(Credits E.-M. Huba & H.P. Mang)