Blue Flame for Brighter Future for Cameroon

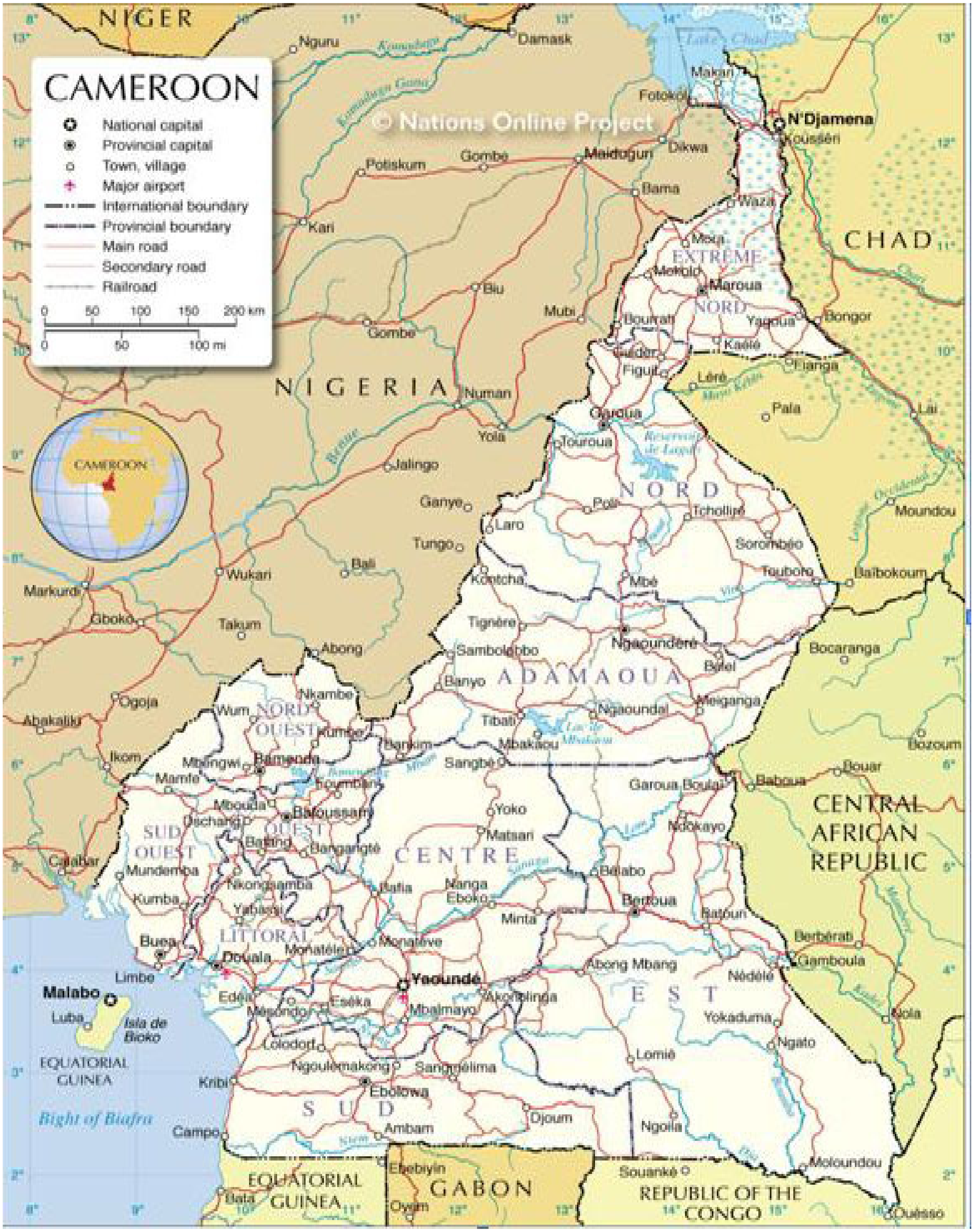
MINISTRY OF ENERGY AND WATER RESOURCES (MINEE)
REPUBLIC OF CAMEROON

NATIONAL BIOGAS PROGRAMME

26 JANUARY 2010

ABBREVIATIONS

(SNV) BPT	(SNV) Biogas Practice Team
AfDB	African Development Bank
BCCC	Biogas Central Coordination Committee
BISO	Biogas Implementation Support Office
BPO	Biogas Programme Office
CBC	Cameroon Baptist Church
CDM	Clean Development Mechanism
CER	Certified Emission Reduction
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GTZ	Organization for Technical Cooperation, Germany
HDI	Human Development Index
hh	Household
HPI	Human Poverty Index
ICS	Improved Cooking Stove
IPCC	Inter-governmental Panel on Climate Change
M&E	Monitoring and Evaluation
MDG	Millennium Development Goals
MFI	Micro Finance Institute
NGO	Non-Governmental Organization
NPV	Net Present Value
NTFP	Non-Timber Forest Products
MINEE	Ministry of Energy and Water Resources
MINFIG	Ministry of Finance and Budget
ODA	Official Development Assistance
OECD	Organization for Economic Cooperation and Development
PANERP	Plan d'Action National Energie pour la Réduction de la Pauvreté
PRSP	Poverty Reduction Strategy Paper
R&D	Research and Development
SNV	SNV / Netherlands Development Organization
SWOT	Strength – Weakness– Opportunity – Threat
ToT	Training of Trainers
VER	Verified Emission Reduction


CAMEROON
National capital
Provincial capital
Town, village
Major airport
International boundary
Provincial boundary
Main road
Secondary road
Railroad
0 50 100 150 200 km
0 50 100 mi
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NIGER
NIGERIA
CHAD
CENTRAL AFRICAN REPUBLIC
EQUATORIAL GUINEA
GABON
REPUBLIC OF THE CONGO
Lake Chad
Bight of Biafra
Isla de Bioko
EXTRÊME NORD
NORD
ADAMAOUA
NORD OUEST
OUEST
SUD OUEST
LITTORAL
CENTRE
EST
SUD
Yaoundé
Malabo
N'Djamena
Douala
Garoua
Maroua
Ngaoundéré
Bamenda
Bafoussam
Buea
Bertoua
Ebolowa
Kousséri
Makari
Fotokol
Waza
Mora
Mokolo
Yagoua
Kaélé
Guider
Figuil
Poli
Tcholliré
Touboro
Tignère
Banyo
Meiganga
Tibati
Foumban
Kumba
Limbe
Edéa
Kribi
Campo
Eséka
Mbalmayo
Sangmélima
Djoum
Lomié
Yokadouma
Moloundou
Batouri
Abong Mbang
Bafia
Nanga Eboko
Maiduguri
Jalingo
Yola
Calabar
Bangui

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CHAPTER ONE: INTRODUCTION

1.1 THE COUNTRY

Cameroon lies in the Gulf of Guinea and borders Nigeria, Chad, Central African Republic, Republic of Congo, Gabon, and Equatorial Guinea. The country is a mixture of desert plains and savannah in the north, mountains in the central regions and tropical rainforest in the south and the east.

Cameroon is a country characterized by diversity. It spans a territory of 475,000 square kilometers and has 16.5 million inhabitants (2005). Cameroon has a rapid growth (+3% on average per year) and high population concentration (74%) on 1/3 of the territory. Cameroon owes its nickname of “Afrique en miniature” to its unique location between the Equator and the Sahel, which produces extremely diverse ecosystems and landscapes. Cameroon hosts 200 ethno-linguistic groups, making its diversity in this area significant. Poverty remains widespread: about 40 percent of the population lives under the poverty threshold of $1 per day.

Like many countries in the developing world, Cameroon faces increasing environmental and development challenges. Crop failure, which are becoming more common especially in the north, often leads to food shortages. The major urban centers suffer from serious problems of overcrowding, energy deficiency and sanitation. Energy problems, both in terms of lighting and cooking fuel, are getting more acute with 60% of the household energy still sourcing from traditional and non-renewable energy sources such as firewood and charcoal. These and many other constraints render the current initiatives in the hydropower and other conventional energy sources inadequate to meet the current demands while they are effective in addressing the growing environmental problems, especially from the deforestation that is taking place at an alarming rate.

Geography

Cameroon's topography has a strong impact on its climate. With more than 2000 mm/year of rain falling on more than 50% of it territory (up to 3000 mm/year in the North-West and 7000 to 8000 mm on the slopes of mount Cameroon), Cameroon is predominantly a humid country. These geographical conditions set Cameroon in a privileged position in Africa. The Ministry of Energy and Water Resources puts the unexploited hydroelectric potential is considerable (295 Twh/year).

Poverty and environment

In rural Cameroon, almost 99% of poor households use fire wood as the only source of energy for cooking. Less than 10% of the rural households have access to electricity. Land degradation at high rate is occurring across many areas of Cameroon and has resulted in

food insecurity in the Sudano-Sahelian zone as well as in the Western zone. The productive capacity of the land is falling because of shorter fallow rotations, low or erratic rainfall, soil erosion, loss of fertility from soil mining, declining soil organic matter content, and overgrazing. Between 1971 and 1998, per capita cereal production declined from 157 to 85 kilograms. Agrosilvopastoral activities account for slightly more than half of Cameroon's gross national product (GNP) and occupy about two-thirds of the working population. This gives land degradation a social dimension as well as an environmental one.

Poverty is more pronounced in rural areas where more than 86% of the poor people are found to be living in close proximity to the nature and extensively dependent on the nature for their livelihoods. Poverty is especially more prevalent among smallholder farmers who are highly dependent on the land. Land degradation threatens the structural integrity of the ecosystems on which Cameroon's unique biodiversity depends. This is happening due to direct and indirect disruptions of the functioning of normal environmental services (for example, soil nutrient and organic carbon retention, and hydrological functions etc) while also checks the short- and long-term productive capacity of the primary sector and represents a key barrier to increasing agricultural yields.

Land degradation is directly leading to more poverty in the country. Cameroon's Poverty Reduction Strategy Paper (PRSP) identifies food insecurity, poor market integration, and unsustainable use of natural resources as major challenges to the rural sector's growth and notes that changes in ecosystems and declining soil fertility, among other factors, deteriorate the productive environment. Land degradation thus represents a fundamental challenge to bolstering economic growth, sustaining rural livelihoods, and reducing the incidence and severity of poverty.

The socio-economic situation

The economic development of Cameroon, as that of most developing countries, rests mainly on the primary sector. Production and export of primary products (cocoa, coffee, cotton, banana, pineapple, rubber, etc) makes Cameroon's agricultural sector the largest in central Africa. The Northern part of Cameroon is subject to *episodic* hunger because of climatic variations (extended dry periods, flooding) and invasion of migrant crickets.

Farming and agricultural resources combined with those of oil and forestry provide a solid case for developing an industrial base that Cameroon could use to boost its development. In 2002, the GDP of the country was estimated at 11,6 billion € which is almost half that of the entire CEMAC zone estimated at 25,34 billon €. Cameroon thus carries significant weight in the CEMAC sub-region. The growth rate is estimated at 4.5 % and the inflation rate is 3 % for 2007 **[INS, 2001].**

On the human development level, Cameroon was 148th out of 177 in 2003 and 142nd in 2005. Douala is the economic capital and hosts 70% of the country's industrial strength.

In terms of socio-economic development, energy has a key role to play in improving company profitability and attracting the private financing indispensable for increasing the country's economic activity and reducing poverty.

Energy scenario in the country

With the support of the United Nations Development Programme (UNDP) and the World Bank, Cameroon has adopted a National Energy Plan For Reducing Poverty (PANERP), the implementation of which shall increase the rate of access to energy in rural and urban areas.

The solar energy available is abundant but not well developed (south zone 4 Kwh/d/m^2, North zone 5.8 Kwh/d/m^2) or regular; the installed power stands at around one hundred KW Crete. Wind power is marginal. The North and some coastal zones have some favourable sites; some wind power stations also exist. Some warm springs exist across large areas, the region of Ngaoundere, the region of Mount Cameroon and the Menengoumba zone with Moundou Lake. The potential for small hydraulic installations (less than 1 MW of power installed) is estimated at 1.115 TWH mainly in the East and West regions. The existing stations were privately used, in the year 2000; two were functioning with a production of 700 MWh per year. The independent production of electricity represents an average of 7% of the AES Sonel capacity. It is mainly concentrated in the agro-industrial and forestry activity zones (SOSUCAM, SONARA). Their location is dictated by the availability of raw materials. This production is based on hydrocarbon or biomass to meet demands in heat and electricity.

Bio-diesel is becoming increasingly and could result in large scale cultivation of palm oil. Currently, almost 108 000 hectares of land is set aside for oil palm cultivation, and almost 30 000 hectares of forests were cleared from 2001 to 2006 to extend cultivation of this plant to produce palm oil that is used for cooking and as food ingredient.

1.2 POLICY AND INSTITUTIONAL ENVIRONMENT FOR RENEWABLE ENERGY SECTOR

Cameroon is the signatory of the United Nations convention on climate change (UNCCC) and has also ratified the Kyoto protocol. Accordingly, some initiatives have been introduced with a view to strengthening the renewable energy sector in the country. These measures were reinforced in 2005 by the creation of a new and a renewable energy fund. (CREF). This fund is created by a South African Bank (E+CO) and the national investment Corporation (SNI). The mission of the Cameroon Renewable Energy Fund (CREF) is to increase the availability, access to capital and the necessary expertise for the development of projects and small and medium size enterprises (≤ 15 MW) to generate electricity through small hydroelectric stations or biomass.

The Department of electricity of the Ministry of Energy and Water resources is sole responsible agency for the promotion of renewable energies in the country. It does so through the Energy Mastery Unit that is a sub–Department of the Electricity Department in charge of: (1) the promotion of energy saving and substitutions inter-energy substitutions, (2) conception and implementation of the development program and promotion of alternative energy, in connection with the Ministries and organizations concerned and (3) identification and vulgarization of the most appropriate technologies to exploit biomass energy resources.

There is also regional initiatives that relate to and could support biogas programme in the country. A Sub-regional entity called the Centre for Renewable Energy has beeing created to support regional initiatives in the sub-region. This Center shall function within the principle of private public partnership (PPP) and will be responsible for the promotion and

realization of renewable energy projects in Cameroon and the region. As this Centre is based shall be based in Cameroon, the potential for the country of benefit from, and lead the region in the renewable energy sector is promising.

1.3 RURAL ENERGY FUND

The Government of Cameroon has recently begun process to set up a Rural Energy Fund (REF) within the Energy Sector Development Project. The Project objective is to increase access to modern energy in targeted rural areas of Cameroon and improve the planning and management of sector resources by all energy sector institutions. Through its intervention, the project is expected to contribute to improved reliability of electricity supply. Increased access to and reliability of electricity are key factors in the realization of the Government of Cameroon's (GOC) growth and poverty reduction strategy.

There are three components to the project. The first component of the project is Rural Energy Fund (REF). This component will help set up a rural energy fund as foreseen under National Energy Plan for Poverty Reduction (PANERP) and the decree establishing Agence d 'Electrification Rurale (AER). A financing mechanism is based on best practice examples from countries such as Mali and Burkina Faso and will streamline interventions and increase the effectiveness of investments in rural energy.

REF could be of particular interest to the National Biogas Programme in view of possible changes to the REF scope to incorporate biogas into the programme funding as biogas demonstrates its ability to significantly meet the rural energy demands, particularly meeting the cooking energy needs.

1.4 POLICY GAPS

A review of existing policies and institutions of the government demonstrates that renewable energy is not yet fully taken into account in the energy policies of Cameroon.

Renewable energy, particularly small scale initiatives to meet the household and rural needs are not adequately highlighted in the documents. The renewable energy is generally referred to in the context of development strategies of rural electrification. Even within renewable energies domain, biomass is given much more attention taking into account the importance of these resources in Cameroon. The transformation of biomass for the production of biogas is less defined in the institutional and regulatory provisions. This demonstrates the need to give more defined, specific and prioritized attention to biogas and similar initiatives by public policies and authorities. This is of particular interest considering that MINEE has passed a bill on renewable energies which is currently being discussed at ministerial level.

The National Biogas Programme, as it evolves, will come to fill these insufficiencies and to provide necessary information to public authorities for a better integration of this form of energy in the future strategies and policies of the Government.

CHAPTER TWO: BIOGAS EXPERIENCE IN CAMEROON

2.1 INTRODUCTION

Biogas is not new for Cameroon. A number of initiatives at the governmental and private level have been undertaken over the past decades. However, in most cases, continuity or the initiatives was lost for a number of reasons and biogas could not expand to wider population for wider benefit to its people and the environment.

Experimental work on biogas carried out in Cameroon at domestic and institutional level over the past years are summarized below.

2.2 EXPERIMENTS AT INSTITUTIONAL LEVEL.

In 1979, a Biogas initiative was carried out by the National Center for Studies and Agricultural Mechanization Experimentation (CENEEMA). This program aimed to place at the disposal of the rural regions, from local available resources, energy provided by biogas and the organic soil conditioner coming from the composting of digesters. From 1979 to 1983, the CENEEMA built in Cameroon 29 biogas plants across the country. The North West and Littoral regions had 17 installations. The following three models of digester, whose capacity varies from 1 and 10 m^3 were tested in this program:

- The Chinese model;
- The Indian model;
- The German model (Darmstadt).

None of the three models was adapted to the Cameroon rural conditions. The Chinese model brought much problem of gas leakage and pressure was not constant. The Indian model had to be abandoned because of draining difficulties. The German model (Darmstdat) was expensive and the mechanical agitator choked from time to time. especially after a prolonged stopping of the digester. To address these difficulties, CENEEMA put designed a new model combining the Indian and Darmstadt models. Two digesters that were constructed at Mbandjoun and Bali Hospitals, and others, were later reviewed after 4 years of operation and were assessed as follows:

- 50% in good operating condition;
- 30% stopped to operate because of the lack of regular maintenance;
- 20% stop to operate for other reasons.

This programme was later abandoned for financial reasons.

Recent institutional biogas plants

These units are developed by the Cameroon Baptist Convention (CBC) in the Bingo, Kumbo hospitals in the North West region, Kumba in the South West region and Douala in the littoral Region. Biogas in these units is used for producing hot water in wash-houses and for cooking purposes.

a. ***The Bingo site****:* the Bingo Baptist hospital has a 40 m^3 digester using human toilet waste and a 150 m^3 digester using cattle dung. The two digesters are semi continuous. The performance of the biogas plants are mixed but are functional.

b. ***The Kumbo site:*** this unit located in Kumbo hospital is equipped with two 40 m^3 digesters and used only human waste. These digesters allow the treatment of waste water from the toilets of the hospital having 250 beds and 400 permanent staff. Biogas produced allows having safe hot water for the wash-house. The waste from digesters is collected for agricultural purpose.

c. The other sites built by the CBC in Kumba and Douala are recent (two and three years) and use the waste from the toilet. Other digesters are also in pipeline to be built at institutional level.

2.3 BIOGAS AT DOMESTIC LEVEL

Some sporadic household level initiatives were noted in rural communities. A plant was owned by Sisters of Babeté (close to Mbouda) in the area of the West region in Cameroon and at Madingring in Rey Bouba Division. The volume of digester is approximately 10 m^3 and produced biogas useful for cooking purpose. The digester in Madingring was abandoned for lack of maintenance while the one in Babeté was still functional. The Lamido of Rey Bouda had also constructed a family digester using cow dung some years ago. This digester, however, had a design problem and is now abandoned.

In the Far North region, COPRES SA in conjunction with a Belgian organization had built several drum-based small pilot digesters but they did not function beyond the period of the tests because of the lack of expertise of the local staff in charge of leading the project.

2.4 LESSONS LEARNT

In Cameroon, there exists great prospects for the households to use biogas for cooking purposes. This is demonstrated in the number of experiment already carried out on the field. Even if the majority of the developed family units did not function well, we note that the experiments realized on the field were carried out by the local actors, often without external assistance. The main points on which the national biogas program can rest shall include:

- need for good design, technologies and a sales-after service. In reality, the performance of the digester rests on the design that influences gas productivity;
- feasibility to mix excreta and of cow dung is not a problem in all the areas, since the passage and mixing is through the underground drains that link to the digester.

- difficulty in availability of feed material and competition with other users can arise in certain communities where cattle is left for grazing. In this case, it would only be necessary to sensitize the stockbreeders to allow some animals enclosed during the night periods in order to have cow dung to fill the digester.

CHAPTER THREE: KEY ELEMENTS OF THE NATIONAL BIOGAS PROGRAMME

3.1 GOAL

The *overall goal* of the National Biogas Programme (hereinafter referred to as the Programme) for Cameroon is to bring tangible and quantifiable improvements in the quality of life in rural households and general rural population in Cameroon. This is to be achieved through propagation and sustained use of domestic biogas taking full consideration of the multiple benefits associated with the development of biogas at the household level.

The Programme will primarily work for the development of biogas at the household level and will be market oriented while support from the governmental and non-governmental agencies will contribute to improved quality, accessibility and affordability of the technology, particularly to the rural poor.

3.2 OBJECTIVES

The *overarching objective* of the Programme is to develop a commercially viable domestic biogas sector in Cameroon. In doing so, the Programme seeks to realize the following objectives to meet its overarching objective:

a. *Increase awareness on global environmental issues and climate change:* This will be targeted at national level to bring high level of awareness among the rural and urban population on the environmental problems associated with natural resource use and climate change and their linkages with cooking and rural lighting practices.

b. *Support growth and strengthen national partner institutions/ organizations: As the biogas sector has to be driven by the national stakeholder, this in a key element for the eventual success of the programme. A range of institutions such as financial companies, contractors, manufacturers, maintenance service providers etc will be engaged in the biogas development process.*

c. *Construct 5,500 biogas plants in the selected Regions of the country in 5 years in a phase-wise manner. The phase-wise development of the programme will reflect existing infrastructures, impacts from the demonstration phase activities and the cost-effectiveness of the plants.*

d. *Help realize full benefits from biogas plants ensuring their sustained use and in coordination with agricultural extension services.* Biogas plants are most attractive when they can be reliably used over a long period with minimal maintenance requirements. Their utility is further enhanced by the use of slurry as manure which increases income generation potential. The agricultural extension services shall be coordinated for more returns for the farmers.

3.3 POLICY LINKAGES

Cameroon is a signatory to the Convention UN Framework for Climate Change and has acceded the Kyoto Protocol. This demonstrates the commitment of the country to promote renewable energies.

Cameroon has recently, in March 2009, promulgated its important national policy document on economic growth and employment generation, *Document de Stratégies pour la Croissance et l'Emploi, Cadre de référence de l'action gouvernementale pour la période 2010-2019* which provides details on its policy for key national development areas. Before this, Cameroon designed its energy action plan for in 2005 for national poverty reduction (PANERP). The vision for energy incorporated in PANERP links energy and poverty and seeks to address MDGs by 2016 by sufficiently modernizing energy services for economic and social development. It recognizes that some 99% of poor households Cameroon use firewood as their sole source of energy for cooking. Only 10% of rural households have access to electricity. The policy discusses the problems in the context of rural electrification and suggests that bio-energy or alternative energy sources are to be explicitly explored.

While there is greater commitment of the country to the development of energy sector, particularly the renewable energy, there is much focus on the hydroelectricity exploiting the huge potential of the country to harness water based power generation. The others forms of energy production, such as biomass, wind and solar energy increasingly attract the national attention but are not yet fully reflected in the policy documents. This could be mainly due to the large gap in the demand and supply, and possible scenario that this huge requirement may not be cost-effectively met by these rather costly sources, particularly to address the industrial needs rather than from environmental considerations.

The policy level priority for development of domestic biogas, therefore, has to be developed from the perspective of national priority to conserve its environmental and ecological wealth while addressing the cooking energy needs of the mainly rural based population that largely depends on the forest products to meet these requirements. In doing so, the biogas development supports the rural households with increased economic opportunities arising from efficient management of slurry manure resulting in increased production levels.

Significantly, development of domestic biogas in contributes to meeting the UN-Millennium Development Goals that have become the national priority for Cameroon. The contributions that biogas can make in meeting these targets are significant, especially for the pro-poor, pro-environment and sustainable energy delivery within a framework that support realization of the overall development targets.

3.4 EXPECTED RETURNS

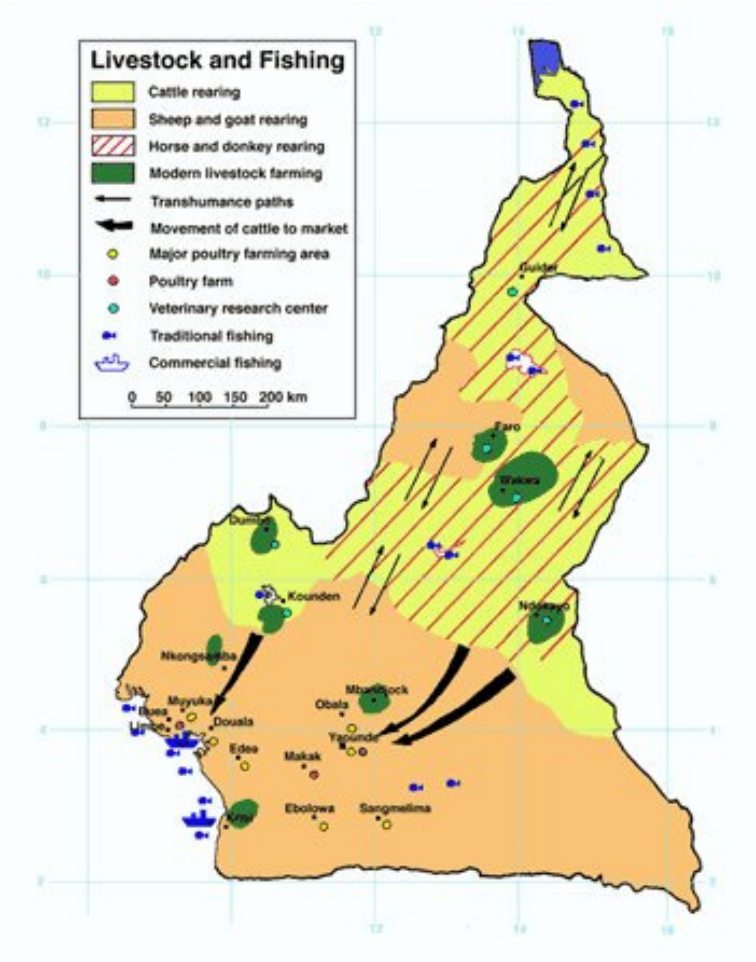
As discussed, the priority of the government of Cameroon is to address the rural energy needs of as much of its people as possible in a cost effective manner and to contribute to the overall economic development of the country. Biogas sector, with its potential for quick growth and direct tangible impacts, can support in realization of national priorities in the following manner:

a) meet with reliability a portion of the rural energy demand at affordable price while contributing to the growth of agricultural and industrial sectors;
b) lower the pressure on unsustainable and environmentally damaging energy sources, including carbon fuel.
c) Promote environmental awareness and energy efficiency in the utilization of energy resources at household and community level
d) promote self-sufficiency in locally derived indigenous energy resources
e) increase energy utilization efficiency and reduce energy waste;
f) promote environmentally friendly energy generation and use.
g) Contribute to employment of rural population through labour-based approach used in the development of bio-digesters and with increased opportunity for maintenance of the plants at the community level.

3.5 NATIONAL BIOGAS PLANT TARGETS

Cameroon has diverse habitation patterns and livestock/agricultural practices due to wide variance in the geography and traditions across the country.

The illustration (see figure on the right and below) indicates that the livestock population is mostly concentrated in the Adamoua, Far North, North and the North West Regions while the remaining Regions have lower cattle population but more goat and sheep farming.



The design of the Biogas Programme has not included the survey of the cattle population but is based on the existing data available. A tentative rough figure from Heifer International active in the livestock sector in Cameroon has around 300,000 cattle owning families in its record. These families are potential users of biogas, as has been demonstrated amply during the demonstration phase activities.

A detailed study of the cattle population, assessment of potential biogas users and the feasible number of biogas plants for Cameroon will be determined at the initial stage of the Programme implementation in Year 1.

3.6 APPROACH TO IMPLEMENTATION

In order for biogas sector to be vibrant and to contribute to the national environment and economy in a tangible manner, the number of biogas plants developed will be important.

For meaningful impact through wider use and dissemination of the biogas technology, market-oriented approach to the development of biogas sector is essential. For this to be realized, it is important that the market considers the satisfaction of the user of the biogas technology. The design, therefore, should be framed has readily available information on the benefits from the biogas sector, including financial incentives and benefits, installation and maintenance costs, operational systems and practices, reliable after-sale services, support in meeting the cost, quality assurance and the longevity of the product. An open, transparent and trustable environment supported with easy access to information will help the users to make quick and favourable decisions. The private sector should then drive the process of actual provision of the biogas plants in a competitive manner so that the user is assured of the best value for the investment made in the biogas digesters.

A number of aspects, such as skill base in the required areas and capacity of the local institutions to adopt and expand their biogas related capabilities, can only be fully understood over time as the programme unfolds. Therefore, the Programme design will take a learning approach to initiate and roll-out the programme. Essentially, the following will be the broader approach to its design and implementation:

a. Stage-wise development of the Programme

The biogas programme will develop in such a manner that there is adequate time for increased awareness to prevail in the country and for appropriate institutions (biogas contractors, appliance manufacturers and micro-finance institutions etc) or their networks to evolve and strengthen with time. The programme will therefore start with the Phase I as

Institutionalization and Growth Phase covering five years (2010 – 2015). This will then be followed by full development phases with higher growth targets.

b. Phase-wise expansion of the regional coverage

Cameroon is characterized by diverse geography and varying human development indices across the five Provinces in the country. These Provinces share the ecological urgency and cooking energy crisis among the rural population, but the skills and capacities of the people and the institutions vary considerably requiring different levels of emphasis in bringing them to a level required for quality growth of biogas sector. As a consequence, the Programme approach will be to address the biogas development in a phase-wise manner so that enough attention can be paid in developing skills in a particular region, starting with the strongest region before moving on to another one requiring more concerted effort.

c. Linkages with regional initiatives for skill and material exchange

Biogas development in Cameroon comes at a stage when similar initiatives are on-going in different countries around the region. The Cameroon programme will therefore the regional initiatives adding strength from experience of the other national programmes. A network approach will be built in to the programme design so that there is ample opportunities to learn and take responsibility in areas of mutual interest, such as sharing of manufacturing responsibilities and development of quality appliances, design modifications, experience sharing on quality control and funding mechanisms etc.

3.7 GENDER AND INCLUSION

Biogas has a great potential to impact the lives of women and provide an opportunity for women to engage with other people and the environment in a more productive and sustainable manner.

Biogas sector contribution to the process of strengthening gender equality and inclusiveness in the society will be most effective only if the design process incorporates gender and inclusive elements and promote their implementation with the support of gender sensitive and inclusive policies. Gender relations have significant impact on the programme with women as main and direct users of the biogas. For this to be integrated, gender analysis with the support of engendering of the data collection and monitoring process, will be built in to the baseline survey and other studies that will be conducted at the start of the local biogas programmes. Gender training will be included to encourage gender-sensitive staff team, design of mechanism, including financial tools, to encourage women to adopt the biogas programme. Gender mainstreaming will be targeted for the whole sector. The programme will strive to have gender-balanced representation in committees and boards.

CHAPTER: INSTITUTIONAL ARRANGEMENTS

4.1 PROGRAMME DEVELOPMENT APPROACH

The development of National Biogas Programme will be realized through a series of phases and stage-wise processes that will be described in later sections, so that the programme is enriched by continual learning and experience sharing over the first five year period of the programme. It is recognized that there was no fully and continually functional domestic biogas plants in the country at the time of starting the preparation for the National Biogas Programme. The Programme development process initiated a Demonstration Phase in the second half of 2009 where first two dozen of biogas plants constructed and used by the families have helped to gain much needed experience on the costs, acceptance of the technology by the households and the skill requirement to feed the design of the Programme.

It is also the approach of the Programme to create as little new institutions as possible and use the existing structures and institutions in implementing the biogas Programme. This important approach is reflected in the design of the Programme.

4.2 ORGANIZATION OF THE PROGRAMME

National Biogas Programme of Cameroon will be owned and executed by the Government of Cameroon. Ministry of Energy and Water Resources (MINEE) will be the 'institutional home' of the Biogas Programme. It will execute the programme. The Government of Cameroon will undertake the Programme through the MINEE.

The Energy Unit within the Department of Electricity/MINEE shall manage the Programme. The day-to-day management of the Programme on behalf of the Unit will be carried out by a 'semi-autonomous' programme Unit called the Biogas Implementation Support Office (BISO).

BISO will have Regional Offices, called Regional BISO (RBISO) in the programme Regions. The expansion of the Programme to different Regions will be achieved in a gradual manner.

4.3 ADVISORY AND IMPLEMENTATION PARTNERS

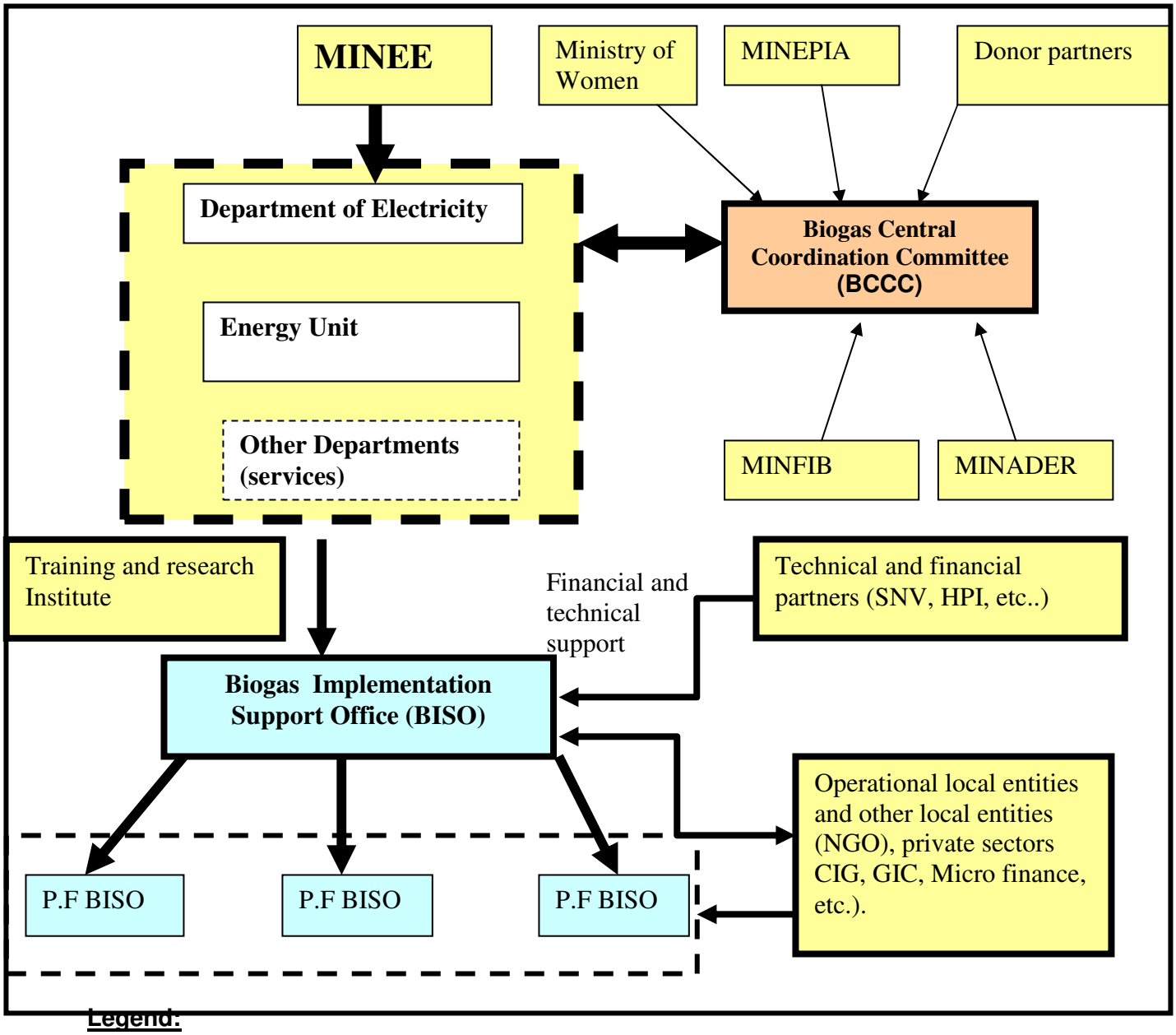
The Programme execution and implementation will be supported by a number of institutions and stakeholders. A central level stakeholder body, Biogas Central Coordination Committee (BCCC) shall be constituted to provide Advisory and Policy Level services working in direct coordination with the Director of Electricity. There shall be secretary level representation in the BCCC from the following Ministries:

- MINEE
- MINEPIA
- MINFIB
- MINEP

- MINADER
- MINPLADAT
- MINPROFF
- Development/Donor Partner representatives

At the implementation level, a range of local partners (NGO, Contractors, MFI, CBOs etc) will be associated with the objective of working together with BISO to provide related services within an agreed framework defined in the MoU that they will have with BISO.

Fig 1: implementation structure of the national domestic biogas programme



4.4 INSTITUTIONAL ROLES AND RESPONSIBILITIES

4.4.1 National level

A. Ministry of Energy and Water Resources (MINEE)

The MINEE shall be the main government entity that shall be responsible for the formulation of policy, laws, and directives for the promotion of renewable energy in general and biogas in particular. The following roles and responsibilities shall be fulfilled by MINEE in undertaking the role of key biogas promoting institution in the country:

- develop a comprehensive information central with databank on the prospect and potential for renewable energy (except hydropower) in the country;
- formulate national level vision, policies and strategies for biogas energy development and institutionalize mechanism to monitor and report at the national level;
- coordinate with academic and private sector institutions to lead the research and development (R&D) of biogas development sector;
- support capacity building initiatives for national level capacity to engage and develop skill in the private and public institutions to implement biogas sector programme;
- monitor and evaluate the National Biogas Programme and coordinate donors, government ministries and stakeholders in renewable energy resources;
- analyse existing policies and policy formulation related to the dissemination of biogas programme; renewable energy technologies, in particular domestic biogas, and act upon accordingly;
- liaise, in collaboration with other concern ministries, with donors and mobilise resources required for the implementation of the National Biogas Programme;
- oversee the progress of the programme, analyze reports and inform the parties or stakeholders accordingly.

B. Ministry of Finance and Budget (MINFIB)

MINFIB will ensure required financial contribution from the government to enable smooth construction and management of the BISO. Consistent with the Annual Programme, it will liaise with the donor agencies for contribution to meet the cost of the Programme. It will support the flow of fund to BISO as well as carry out the following:

- finance and promote National Biogas Programme through its inclusion in regular budgetary planning;
- carry out periodic impact monitoring;
- maintain disbursement level of programme funds upon satisfactory performance of the programme.

C. Department of Energy

The DoE will work on its behalf of MINEE and carry out the functions stipulated for the Ministry. The Head of the DoE shall also be the Head of the Biogas Programme.

D. Biogas Central Coordination Committee (BCCC)

This shall be a powerful body with senior level representation to ensure a national level commitment in policy formulation and sustenance of funds for the approved programme. The following key national actors will be responsible for coordinating and guiding developments in the biogas sector. It will meet twice a year or more, and will be responsible for the following:

- adequacy of policy tools and support in policy development where necessary
- review annual plans and reports for the biogas programme
- review and endorse terms and conditions for partner organisations;
- promote and prioritise biogas programme among international partners and venues such as Biogas Africa Initiative.
- advise and ensure provisions for sector-wide quality standards and guidelines;
- undertake periodic review of progress, standards met and policy appropriateness

The members of this committee shall constitute of:

- Representatives from MINEE;
- One representative from MINEPIA;
- One representative from MINFIB;
- One representative from MINEP;
- One representative from MINADER;
- One representative from MINPLAPDAT;
- One representative from MINPROFF;
- Two representatives from Development/Donor Partner representatives (including one from SNV)
- One Representative from Department of Energy (designated as Member Secretary);
- One representative of Training and Research Institution.

During the course of the design of the Programme, a Working Group for the promotion and development of biogas in Cameroon has been created by decision n°0354/MINEE/CAB of the Government of Cameroon on December 24, 2009. This Working Group has the

mandate to facilitate the institutional framework development for the biogas programme and to support the implementation process. The Working Group shall later be converted into BCCC as defined in the Programme document.

E. Biogas Implementation Support Office (BISO)

BISO shall function as the main body to implement National Biogas Programme on behalf of the MINEE/ Department of Energy. It will coordinate all the field level implementation as well as capacity building and engagement with biogas stakeholders. It will coordinate with Biogas Central Coordination Committee at the highest level to the biogas users at the grassroots level.

It will be established as an semi-autonomous project office physically located outside the Ministerial premises for easier access and flexibility of operations. The BISO will be mandated to undertake the day-to-day management and coordination of all programme activities. The function of the office will include financial management, programme implementation and staff management. This will be carried out as per the programme rules and regulations. It will report to the Department of Energy/ MINEE.

Its staffing will broadly constitute of:

- National Biogas Programme Manager
- Administrator
- Promotion and marketing Officer
- Quality Control Officer
- Biogas technicians
- Agriculture Slurry Extension

In addition to these staff members, a set of Technical Assistance (TA) will be engaged with the BISO to support it in carrying out its functions.

The effectiveness of this program relies on the BISO which should be equipped with qualified staff and sufficient means to enable it to achieve its goals.

At the Regional level, the BISO shall have a Regional BISOs (RBISO).

F. SNV Cameroon/ Donor bodies

SNV in Cameroon promotes local institutions and community is building their capacities with the aim of improving governance and reducing poverty. Consistent with its worldwide mission, SNV in Cameroon will support services through training and coaching, technical advice, facilitating change processes, support to mechanisms for advocacy, networking and partnership building including intermediation for information, expertise and funds, and knowledge development and dissemination.

SNV's contribution to the Programme will be guided by its strategic positioning in the renewable energy sector as outlined in its strategic document for 2010-2012 (SNV, May 2009). Biogas shall remain at the heart of SNV support in Cameroon while it will explore opportunities to work with other bilateral and multilateral development partners to seek

support for the biogas development in Cameroon consistent with its policy of engaging in the development of biogas in Africa.

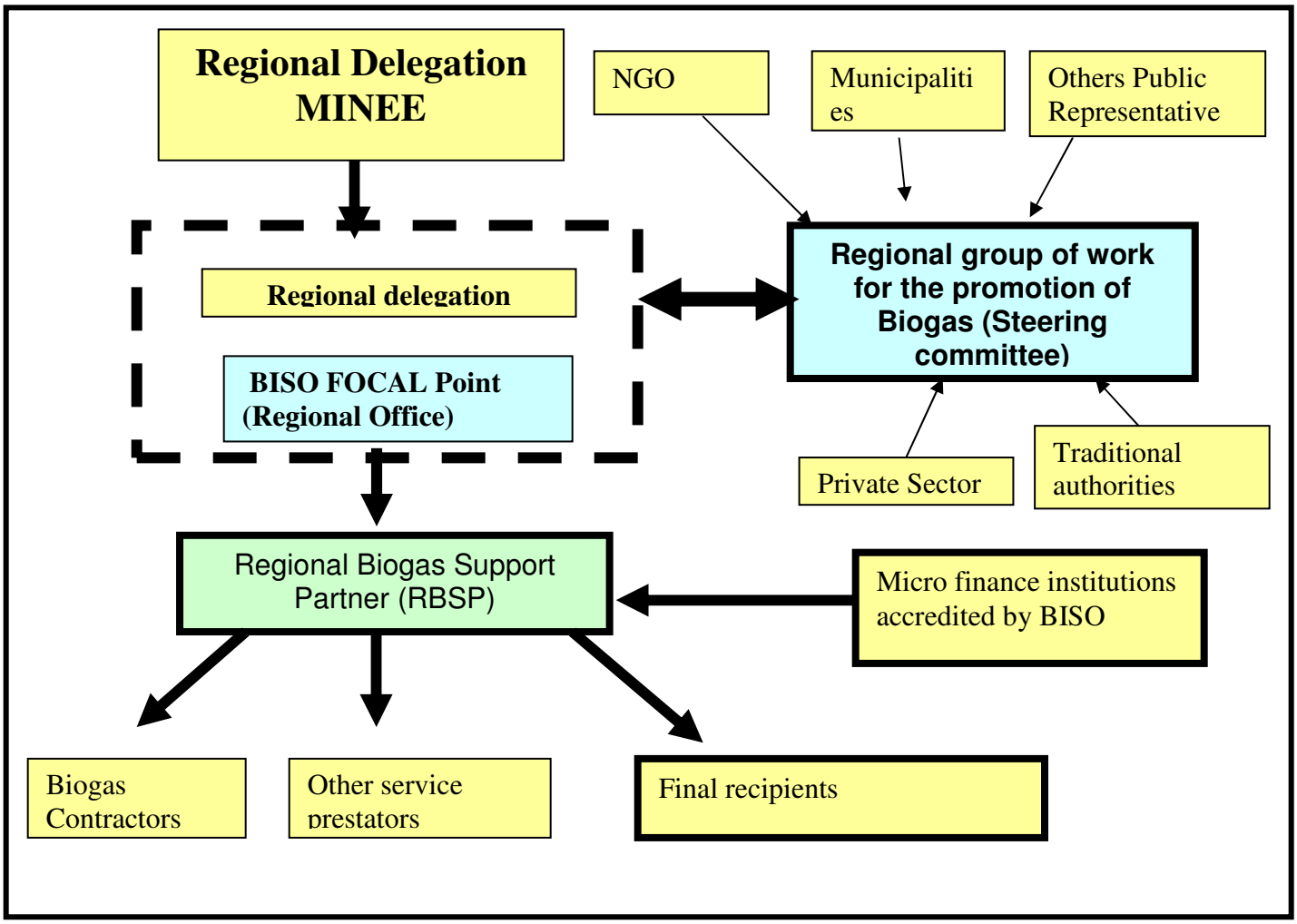
4.4.2 Regional and local level

At the Regional level, BISO will work through RBISO who office shall function as the Regional focal point for all the biogas activities in the Region.

At the regional and local level, implementation activities will be carried out through Regional Biogas Support Partner (RBSP), which shall be an NGO that will be engaged by RBISO to facilitate the implementation process. This NGO, selected among the most motivated actors on invitation to tender for the management of the project on the field, will carry out the functions as summarized below:

- Promotion and marketing of the program at regional level;
- management of the selection process of the recipients on the basis of criteria put in place by the BISO and the Regional Pilot Committee;
- Mobilization of the participation of the recipients (in terms of nature or in terms of money);
- Recruitment of the technicians (mason) trained for constructing digesters and their maintenance;
- Identification of the demands for the construction of digesters;
- Training of technicians and recipients to a better use of the digesters;
- follow-up of the construction activities of digesters in collaboration with the BISO focal area;
- work in conjunction with micro finance institutions approved by the program for the management of funds for construction;
- Reporting and preparation of the annual capital spending program at regional level.

Chart 2 : Implementation structure of the national domestic biogas programme (Regional Level)



Existing Structure

Structure to be created

Existing Structure to be contract with BISO

Other regional and local partners that shall be involved in the programme will be as follows:

A. Regional Office or Focal Point of BISO which shall carry out the following functions:

- Follow-up of the program at the regional level,
- Lead the Regional Biogas Steering Committee.

B. Regional Biogas Steering Committee (RBSC)

This committee will have the same composition as the BCCC at the national level. Its members will include :

- regional delegation of Ministries in the BCCC,
- representatives of council;
- representative of traditional authorities;
- representative of local NGO interest by the programme;
- private sectors involved in the programme (e.g. biogas contractors' body, biogas appliance manufacturers, agricultural entrepreneurs etc)

The functions of this committee shall be :

- Selection of the recipients of the biogas programme on the basis of criteria put in place by the BISO,
- agreement of subsidies,
- definition of specific criteria for vulnerable households,
- follow-up of the program at the regional level.

C. Local Administration at Village/Community level

The local administration unit will support the Programme in the following manner:

- Provide long- list of names for construction and maintenance training for screening by the RBISO
- Support the training process with the provision of local materials and supplies.
- Support data collection, response and other studies at the local level.
- Help in engaging local government, line agencies, non-government and private organizations to streamline related activities (such as agricultural extension etc) with the biogas programme.

D. Micro-finance Institutions (MFI)

These services of these institutions are essential for scaling up biogas programme. However, a detailed study will be needed to develop suitable approach and make appropriate policy recommendations before these institutions can be fully developed. Currently, the MFIs network in Cameroon is limited and their services expensive.

It will therefore be appropriate to use MFI services in a phase-wise manner. At the initial stage I of the Programme (Year 1 and Y2), an MFI will be identified and supported directly by the BISO for credit services. A more competitive and wider application will be designed in the subsequent stages of programme development.

E. The private sector

The private sector involvement in the biogas sector takes place for the following activities:

- biogas construction companies who construct biogas plants for the clients (plant owners)
- biogas appliance and component manufactures
- biogas financial intermediaries who can provide credit at affordable rates to the client
- biogas related NGOs who help to promote technology and disseminate advantageous use of biogas and slurry.

The role of these partners are very important in the implementation of the biogas programme. The manufacturers of appliances and components grow with the programme and play an important role in its success. Private construction companies are key partners who not only deliver the product, but can also promote the technology in the process of their business development. Where there is healthy involvement of the private sector with provision of cost effective services with good quality standards, the biogas programme thrives and becomes self-sustaining.

4.5 FLOW OF FUND

The fund for the biogas programme will be kept in an account entirely committed for the national domestic biogas programme. The possible funding sources will include:

- Government contributions from public investment budget coming from MINFIB
- International NGO involved in the programme: technical and financial support;
- External Donor contributions;
- Local contribution from beneficiaries (financial, labor and material).

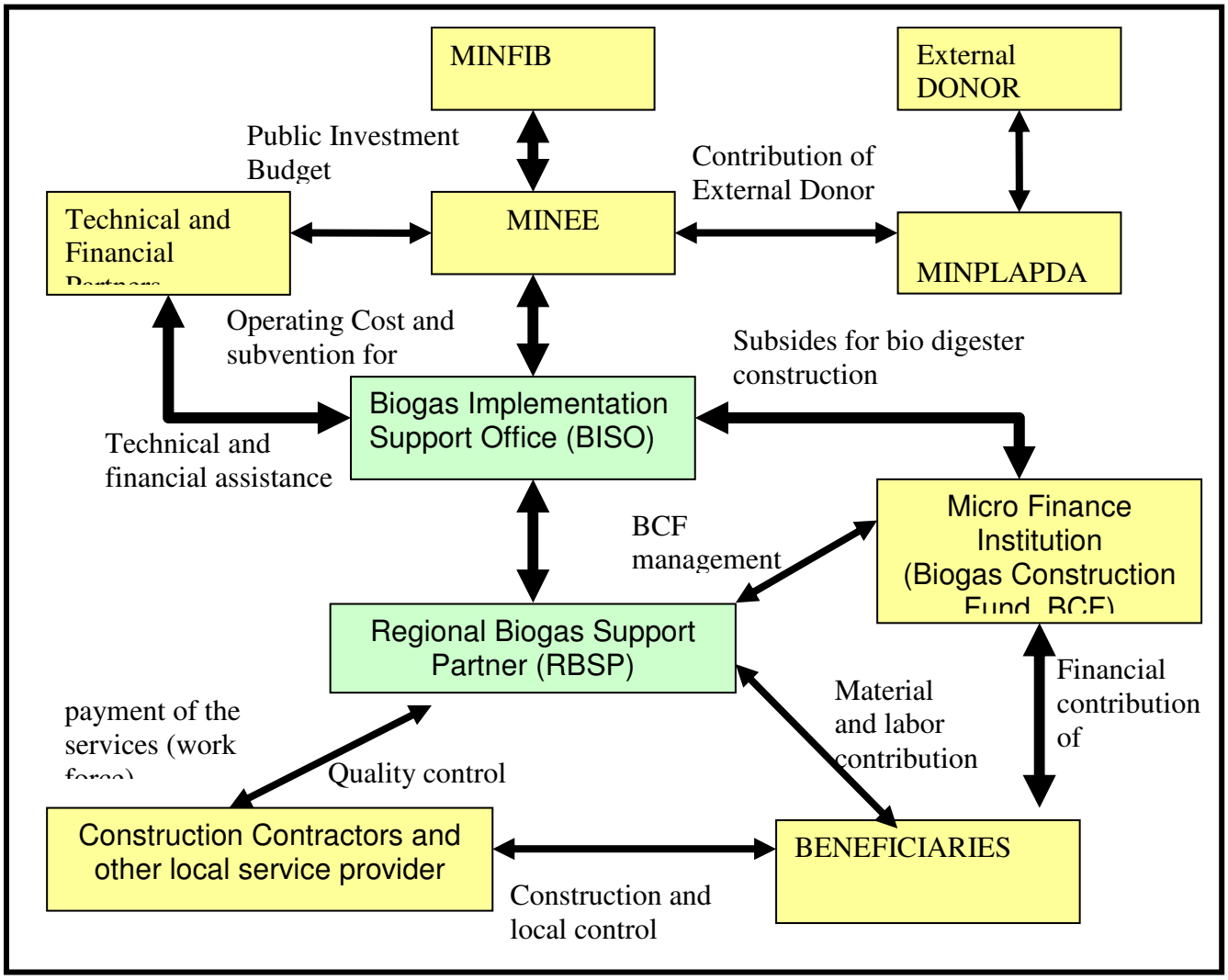
The account will be managed by BISO on behalf of MINEE with the periodic overview of MINFIB and the Donors. The BISO shall be responsible for the management and administration of the funds.

The basis for the expenses shall be approved document of Annual Programme Implementation consistent with approved annual plans and guidelines.

External Donor funds will be received and channeled through MINPLAPDAT and deposited directly in the programme account management by BISO.

Implementation level flow of funds:

Chart 3 : Implementation level fund flow and the national and regional level.



At the implementation level, there shall be five major actors associated with the flow of funds (see Chart 3 above):

- The client (the biogas user);
- The construction agent/ contractor ;
- Financial Management Intermediary (FMI);
- Biogas Regional Support Partner (BRSP)
- Biogas Implementation Support Office (BISO).

At the regional level, the flow of fund will take place as follows: The BISO transfers to the account of RBSP the contribution of the construction cost. The beneficiary puts into the same account his financial contribution. The RBSP prepares the contract for the Construction Contractor (CC) and asks FMI to pays the advance to CC. The rest of construction cost will be paid to CC after the confirmation of the satisfaction of the users, positive construction completion reports and the approval of the quality control inspectors from RBSP. The user of the biogas plants will sign for the receipt of the contribution to construction cost. The total amount of the contribution to construction cost will then be deducted from the overall bill for the construction by the construction contractor.

The funds for the contribution to construction cost shall be transferred bi-annually to the account of RBSP.

CHAPTER 5: PROGRAME IMPLEMENTATION ACTIVITIES

5.1 ANNUAL PROGRAMME FRAMEWORK

Capacity of the stakeholders to plan, undertake and ensure quality of the biogas plants will be a key consideration in the development of biogas plants in Cameroon. Accordingly, a phase and stage wise programme development approach is adopted to cover to the whole country and to development implementation capacity gradually over the years.

The summary of annual activities is tabulated below:

YEAR 1: TRANSITIONAL/DEVELOPMENT YEAR [TARGET 150 PLANTS]

Policy and organisational set up.
Procurement of services (process year)
Capacity building on quality control.
Awareness and promotion.
Team expansion (at latter part of the year).
Subsidy and credit component studies and institutional arrangements

YEAR 2: PROGRAMME YEAR 1 [TARGET 500 PLANTS]
Policy development
Office set up and procurement completed
Training and capacity building
Research and development
Awareness and promotion

YEAR 3: PROGRAMME YEAR 2 [TARGET 1000 PLANTS]
Policy development continued.
Training and capacity building for expansion
Research and development continued
Awareness and promotion continued

YEAR 4: PROGRAMME YEAR 3 [TARGET 1500 PLANTS]
Policy development continued.
Training and capacity building for expansion
Research and development continued
Awareness and promotion continued

YEAR 5: PROGRAMME YEAR 4 [TARGET 2500 PLANTS]
Strengthening of manufacturing base
Training and capacity building for expansion
Research and development continued
Awareness and promotion continued

These activities will be detailed out in Annual Implementation Plans to be developed each year based on the Project Implementation Document (PID) which will be developed at the beginning of the Programme implementation.

5.2 PROPOSED REGIONAL DISTRIBUTION OF PLANTS

Cameroon does not have equal or even distribution of population or livestock across the country. Its livestock rearing practices also widely vary from Region to Region. As a result, the targeting of the plants can only be ascertained only when a detailed study, as outlined in Section 3.5, is carried out at the start of the implementation of the biogas programme.

For indicative purposes, the following distribution is suggested based on the demonstration phase experience (limited to 3 Regions), and this will be revised when more information is known.

S. No.	Region	YR 0 (Demo-Phase)	YR 1	YR 2	YR 3	YR 4	YR 5	TOTAL
1	Extreme North	4	15	50	100	200	400	769
2	North	6	15	50	100	200	400	771
3	Adamaoua	0	40	150	250	450	750	1640
4	North West	13	80	150	400	500	750	1893
5	West	0	0	50	100	100	150	400
6	Central	0	0	10	10	10	10	40
7	East	0	0	10	10	10	10	40
8	South East	0	0	10	10	10	10	40
9	Littoral	0	0	10	10	10	10	40
10	South	0	0	10	10	10	10	40
	TOTAL	23	150	500	1000	1500	2500	5673

5.3 TRANSITIONAL PHASE (PROGRAMME YR1)

This phase is designed to takes forward the preparatory activities to meet the higher target needs of the full programme development phase in Year 2 and onward. During this Phase, it is anticipated that all the institutional set up that is required for the fully-fledged programme implementation will not have materialised until the end of the year. There will, however, a BCCC in place to start and drive the policy and institutional development process. As a result, there will still be some gaps in actual delivery of the biogas plants in a fully structured manner.

In view of this, Transitional Phase is designed to:

- Continue the construction of biogas plants during the developmental stage
- Widen the learning process
- Expand to one additional Region (i.e. Adamoua)
- Train for additional human resources to meet steep rise in biogas plant numbers from YR2 onwards.

This will be implemented directly by the SNV in coordination with MINEE. It will be a centralized approach managed from the centre with support from field based SNV offices.

It is recommended that the procurement of non-local materials (such as pipes and pipe fittings, appliances etc) carried out centrally on a competitive basis for the whole annual programme and distributed to the plant sites. This will contribute to reduction in time taken for individual procurements as well as support to reduce the unit cost of the plants.

a. Staffing Resource Matrix:*

S. No.	Staff levels/ positions	Number
1	Biogas Advisor (International- intermittent input)	1
2	Biogas Technical Monitor (International – field based)	1
3	Biogas Manager (National)	1
4	Biogas Supervisors	2
5	Biogas Masons (output based individual contracts)	10

Note: This does not include existing internal SNV staff assigned for biogas programme. Lumpsum costs are presented in the summary cost tables.

b. Main activities in the YR 1

This phase activities will prepare for larger programme development while maintaining momentum with 150 additional biogas plants in selected regions of the country. The following activities will contribute to this objective:

(i) A core team of minimum essential structure as identified above will be established and managed by SNV Cameroon in close coordination with MINEE to spearhead the transitional phase.

(ii) Annual Plans, including procurement and activity plans will be prepared for the year and biogas household identification and plant award process will be initiated.

(iii) MINEE will commence the agreed policy and institutional development processes to install by the end of 2010 a fully functional biogas structure for fully-fledged programme.

(iv) A series of targeted on-the-job training will be organized for capacity building and institutional development of the private sector individuals.

(v) Awareness and promotional activities will be designed and carried out throughout the year.

(vi) Specialized studies on subsidy and credit arrangements, private sector development etc will be carried out to feed to the implementation modalities to be adopted by the Programme.

(vii) A full team development and appropriate set up will be realized at the end of the Transition Phase year.

S. No.	Key Activities	YEAR 1: MONTHS												Remarks
		1	2	3	4	5	6	7	8	9	10	11	12	
1	Staff recruitment and team development													
2	Annual activity and procurement planning including fiscal arrangements													
3	YR2 to YR 5 preparatory works on policy update and institutional set up													
4	Refresher training and quality control mechanism established													Simultaneous works in multiple regions.
5	Field survey, household identification and start of field work													
6	Design, production and nationwide dissemination of awareness and promotion materials													
7	Procurement of services and establishment of YR 2 programme set up (offices, staff, equipment etc)													
8	Training and capacity building activities													On-going activity at field level
9	Year 1 Output Evaluation Workshop													

The Year 2 to Year 5 activities will be designed and implemented following detailed implementation plan that shall be developed in the Year 1 as above.

5.4 ASSUMPTIONS FOR FIELD STAFF LELVELS

From experience of developing nearly 2 dozens of biogas plants during the Demonstration Phase and the experience in other countries, the following resources will be required in carrying out field level biogas construction and supervision works:

- A Supervisor can supervise an average of 10 plants at a time.
- A biogas plant will require full time engagement of 1 Head Mason (with support mason only to help the Chief mason).
- A Head Mason can plan in such a manner than he/she provide input into 3 plants concurrently.
- In one month, a qualified Head Mason can deliver 3 Bio-digesters in an Area (preferably within a cluster of households).

Staff resources	***150 Digester*** (Yr 1)	**500 Digester** (Yr 2)	**1000 Digester** (Yr 3)	**1500 Digester** (Yr 4)	**2500 Digester** (Yr 5)
External Quality Monitors	1	1	One per 2 Regions	One per 2 Regions	One per 2 Regions
Masons (Yr 1)*	15	Masons will be provided through Contractors from Yr 2 onwards			
BISO Supervisors (Field Quality Monitors)	2	5	10	10	10
Plumber* (with helper)	1	Contractor will provide plumbing services			

Note:

- External Quality Monitor is generally one per Province when the number exceeds 500 plants.
- Field Quality Monitors will also be trained to provide maintenance and after sales services.
- Separate plumbing services will be provided in the first year. Thereafter, Masons will be trained to provide plumbing services as well.
- Masons will be replaced by Contractor services from Yr 2 operations.
- BISO Supervisor can provide supervision to one cluster or two clusters if they are nearby. They should ideally visit a plant at least once day, and this is compulsory if concreting work is going on.

5.5 TRAINING REQUIREMENTS

The Biogas Programme will undertake a number of training sessions for different skills requirements for different functions. Refresher training will follow main training activities to ensure that the skills are consistent and updated. The following training courses are envisaged:

Mason training

Training of masons will cover the technical skill requirement as well as promotion , plant sizing and selection, user extension (e.g. how to explain to the user about the operation and maintenance responsibilities, daily inspections, small repairs etc) and handling feedback from users. The training frequency, duration and course will be determined at the implementation level.

Mason refresher training

Trained masons who are active in the biogas construction will receive refresher training. Preferably every mason should get such training one year after completion of his mason training. If the quality of a mason's work is not good enough, additional training can be made compulsory.

Supervisor training

The supervision load will be shared by biogas companies and BISO. However, BISO will organize training both for the contractor as well as BISO staff.

Field Quality Monitors

BISO will have a range of Monitors that it will train and put in the field to monitor and report quality of the works. Their report will be the basis for the final payment to the contractors.

Managers' training

RBPCOs and company managers of construction companies and private companies (MFIs, NGOs etc) will be trained in business management, marketing, promotion, quality management, programme management and related issues.

Study tours

A series of study tours for different types of groups (e.g. farmers, entrepreneurs, agricultural etc) to demonstrate biogas activities, benefits and potentials will be organised annually.

CHAPTER SIX: PROGRAMME COMPONENTS AND COST

6.1 SALIENT FEATURES OF THE PROGRAMME

The salient features of the Cameroon National Biogas Programme will include:

Transition Phase: The Programme will commence from 2010 with the Transition Phase in Year 1 of 5 years (2010 to 2015) to better understand performance and potentials of a number of sub sectors such as livestock, agriculture potentials, private sector participation in construction and micro-financing etc that are important prerequisites of up-scaled biogas sector in the country.

Detailed sectoral studies: The Programme is also characterised by allocations for a number of detailed studies, targeted to be carried out during the Transition Phase, to establish potential number of biogas plants and the detailed approach to reach out to the most disadvantaged corners of the country, particularly the north and extreme north provinces of the country. Similarly, studies will also be targeted at other possible and viable renewable energy technologies (RET) such as Jatropha-based bio-fuels and solar home systems for non-livestock based households and communities. The studies will therefore explore potentialities for sustainable energy systems to support the biogas programme in a sectoral manner and to be carried out within a broader national energy policy and stakeholder framework.

Biogas plant output: The Programme will target to support the development of at least 5000 domestic biogas installations in the country during the first five years of Development Phase (2010-2015).

*Harmonisation of standards for technical and service quality systems: Quality c*ontrol in construction, materials, after sales and extension services will be stringently followed to safeguard the investment of the farmer and enable the farmer to ensure maximum benefits from the investment. The quality management system that will be developed and applied will be at par with quality assurance certification requirements at the highest possible level and to meet the CDM registration standards.

Financing model with pro-poor subsidy: The Programme incorporates provisions for a flat rate subsidy allowance of 30% of total bio-digester cost to reduce initial investments by the farmers. This will be supported by provisions, to be gradually developed, to encourage MFI to provide credit to the farmers at an affordable rate of interest.

6.2 ACTIVITIES AND BUDGET HEADINGS

The costs headings are developed based on the broader programme components. Detailed annual activities shall be developed each year for the following year's approved programme targets and will be as per the Programme Implementation Document (PID) that shall be prepared before the Programme implementation commences.

a. Biogas plant production cost

The Programme proposes to support the construction of 5,000 biogas plants over five year period of development phase. Production per year will be gradually increased and province coverage increased over the years. For the preliminary costing purposes, the following assumptions are made:

- While plant sizes will vary from family and family from 4 cum to 10 (or more in exceptional cases), a size of 8 cum can be assumed to represent average size.

- The cost of preparing plant of 8 cum varies from Province to Province, with Extreme North being the most expensive and Bamenda the most cost effective. The average cost of a plan, therefore, could be assumed to be CFA 6,50,000 [or USD 1450 excluding contractor or supervision costs] per plant for construction related costs.

As a result, the production cost for 5650 biogas plants, including contractor profits at 10%, comes to USD 9.5 million (at rate of I USD = CFA 450).

b. Farmer cost and subsidy.

The discussion on the necessity and advantages of subsidy is discussed in Section XX. For the sake of simplicity as well as to provide advantageous position to rural and lower income level potential biogas users, a flat subsidy rate of 30% across all biogas size installations in all the provinces of the country is proposed.

This gives a subsidy requirement of USD 2.7 million over the five year period.

Table 6.1 Direct costs

Annual costs (USD)	*Not adjusted for inflation*						
Cost element	*Base cost/ plant*	*Yr 1*	*Yr 2*	*Yr 3*	*Yr 4*	*Yr 5*	*Total (USD)*
Annual plant output (number)		150	500	1000	1500	2500	5650
Plant cost (total investment)	1600	240000	800000	1600000	2400000	4000000	9040000
Farmer cost (%)	70	168000	560000	1120000	1680000	2800000	6328000
Assumed subsidy cost (%)	**30**	**72000**	**240000**	**480000**	**720000**	**1200000**	**2712000**

c. Credit.

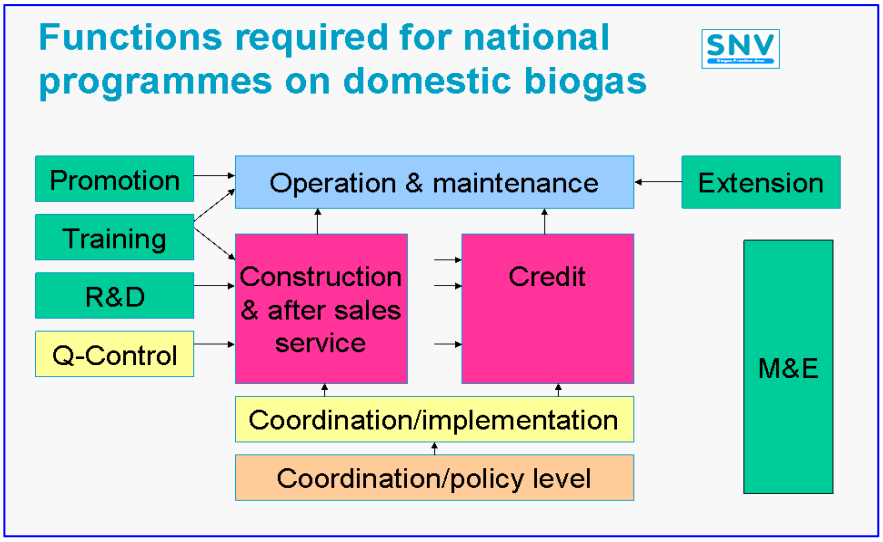
Subsidy provision will be supported along with a well designed credit facility for effective uptake of the biogas plants by the farmers. It is often the case that subsidy alone is not effective, nor credit only approach attractive enough for the poor farmers to take up the technology.

The details of the credit facility arrangements is discussed in Section 7.

The Programme estimates that approximately USD 1.0 million would be required to cover the financing costs of the credit facility.

d. Programme support.

Implementation of the National Biogas Programme will require a robust and comprehensive programme implementation structure in place. The programme support fund will finance the staffing and functions of the Biogas Implementation Support Office (BISO) as outlined in the Institutional Structure set-up and the detailed Programme Implementation Document, PID, to be developed later by the Programme.



In order to meet the objectives of the Programme in a holistic manner, the design of the programme includes a series of activities that address the main functions of a large-scale domestic biogas programme. These are broadly grouped into different component activities summarised as follows:

Table 6.2: Programme support functions

SN	Component	Component Objective
1	Awareness and promotion	This will stimulate demand, inform beneficiaries and stakeholders of the benefits and costs of domestic biogas.
2	Financing	This will lower the financial threshold for the farmer and improve access to credit with particular focus on the poor, women and other disadvantaged groups.
3	Construction and After Sales Service (ASS)	This will facilitate the construction and long term operation of 5000 domestic biogas plants.
4	Quality Management	This will ensure the effectiveness of the investment in biogas and help sustain consumer confidence in domestic biogas technology.
5	Training	This activity help biogas stakeholders to provide appropriate and quality services ultimately helping to propagate the benefits from biogas plants.
6	Extension	This will help to diversify the benefits of biogas plants and maximize returns.
7	Institutional Support	This maximizes the capabilities of biogas related institutions to provide the services and support required by the biogas sector to facilitate access to

		domestic biogas and the development of quality biogas products.
8	Monitoring and Evaluation	This enables timely progress and impact assessment and provision of necessary feedback or back up support with appropriate interventions targeted effectively.
9	Research and Development	This is needed to increase knowledge about domestic biogas issues to maximise effectiveness, quality and service delivery of the biogas programme.
10	Programme management (National / Regional)	This helps with required managerial support, coordination and supervision to drive the process of a commercially viable biogas sector.

The support activities are mainly support costs in various activities and support measures is estimated at USD 1.8 million as follows:

Table 6.3: Programme support budget

S. No.	Expense Item	Yr 1	*Yr 2*	Yr 3	Yr 4	Yr 5	Total (USD)
1	Awareness and promotion	10000	25000	50000	55000	55000	195000
2	Finance	3000	5000	10000	15000	20000	53000
3	Construction and ASS	10000	14000	20000	25000	30000	99000
4	Quality Assurance	25000	50000	60000	75000	80000	290000
5	Training	40000	50000	50000	50000	40000	230000
6	Extension	10000	12000	15000	15000	15000	67000
7	Institutional Support	12000	15000	15000	15000	15000	72000
8	Monitoring and Evaluation	20000	30000	40000	40000	40000	170000
9	Research and Development	25000	30000	20000	25000	25000	125000
10	Project Management	50000	80000	100000	120000	145000	495000
							1796000

e. Technical Assistance (TA)

Technical assistance (TA) to the National Biogas Programme will be essential for its successful implementation, assurance of quality and bring dynamism to the programme. The TA team will comprise international and national/regional experts to enable a learning process where international experience will be shared and developed in the Cameroonian environment.

A total of USD 1.18 million, as derived below, is envisaged for the Technical Assistance services.

S. No.	*Expert/Position*	*Total months*	*Rate/month*	*Total (USD)*
1	Senior Biogas Advisor (International)	30	15000	450000
2	Biogas Technical Monitor (International)	60	6000	360000
3	Senior Biogas Advisor (National)	60	2000	120000
4	Junior Biogas Quality Monitor (National)	60	1500	90000
5	Additional advisory services	LS	-	40000
6	Support expenses	60	2000	120000
	Total estimate			**1180000**

f. Budget summary.

The total programme budget, inclusive of the cost covered by the farmers, comes to a total of USD 10.19 million as follows:

Table 6.4: Total National Biogas Programme cost and potential sources

S. No.	*Expense Item*	*Amount (USD million)*	*Percentage of total*	*Potential source*
1	Farmer investment	6.3	48	Farmer
2	Investment subsidy	2.7	21	National Gov/Donor
3	Credit facility service	1.00	8	Farmer
4	Programme support	1.80	14	National Gov/Donor
5	Technical Assistance	1.18	9	Donor
	TOTAL (USD Million)	**12.98**	**100**	
	Per plant cost (USD)	*2300*		

6.3 SOURCING OF THE FUNDS

The summary of the required funds and its analysis demonstrates that nearly half of the budget (i.e. around 48%) will be covered by the biogas plant owners to build and service their loans through interest payments. Subsidy support, programme management support and the Technical Assistance (TA) will most likely be covered by combined fund of the Government and donor agencies.

In view of the fact that the Government of Cameroon had not anticipated the investments in the biogas sector during the budgetary process for 2010, current budgetary allocations do not directly relate to or provide funding allocations that could be required to fund the biogas programme. However, the government has shown significant interest in exploring potential areas where resources could be requested or diverted for the biogas programme and will inform the stakeholders and donors accordingly.

6.4 POSSIBLE REVENUE FROM CARBON FUND

Biogas is carbon-neutral process and therefore its value lies in its ability to replacing fuels that emit greenhouse gasses through consumption of non-renewable fuelwood, kerosene, petrol products etc. Because of this, the planned biogas programme in Cameroon could actually generate significant revenue using the mechanisms, such as CDM, Gold Standard and various smaller initiatives, that are in practice to generate revenue from this reduction. Each plant is expected to generate carbon credits of 2.2mmt of carbon dioxide equivalent in the voluntary market based on Baseline Methodologies being developed by WWF Gold Standard at present (Uganda Feasibility Study, Winrock International, May 2007). If this would be the case, a plant would generate a revenue of $22 per year at today's market prices for carbon from small projects. The revenue from possible marketing of carbon credit could be used to provide, among others, subsidies for additional plants.

A detailed approach will be worked out to incorporate the lessons so far from other countries in carbon revenue generation and a methodology designed for the Cameroon National Biogas Programme.

CHAPTER SEVEN: SUBSIDY AND CREDIT ARRANGEMENTS

7.1 INTRODUCTION

The investment costs and the financial incentives, such as subsidy and accessible credit schemes, have important role to play in motivating a potential farmer to install biogas plant. Financing is required before the construction and installation works take place and often becomes a major contributor in decision-making process leading to adoption of the biogas plant. Therefore, financing is a key link in the chain connects promotion of biogas to actual realization of the plant by a farmer.

7.2 SUBSIDY

Subsidy is often found to be helpful in the initial development of the market for biogas. It makes the biogas plants more affordable to the farmers. This, in turn, makes biogas attractive for private companies to invest as they see larger numbers being built encouraging them to invest in expanding their capacity in the sector. Moreover, subsidies have also been effective tools to discipline participating private companies by enforcing quality control of the constructed plants. This has more positive effects as the installation of high quality plants further ensures confidence in the product and results in the growth of the market.

Following the positive impacts of subsidy in ensuring quality and catalyzing the market, what matters in financing of the biogas programmes is the actual amount of subsidy. This is not always clear and easy to ascertain. Various views have been developed: a lower level of subsidy would result in a more robust program from the point of view of sustainability. A higher level of subsidy would increase market demand for biogas. *A larger percentage of households that are purchasing between 0-60% of their firewood at present could justify investing in household biogas if a higher subsidy would be available (Feasibility Study, Uganda, 2007)*.

Therefore, design process for the subsidy allocation would need to consider the following questions about investment subsidy (SNV International Workshop Proceedings, 2008):

- What is the justification of investment subsidy?
- How effective is subsidy? How sustainable is subsidy?
- Does subsidy not distort the market?
- Does subsidy take away the incentive for innovation?
- Is subsidy pro-poor?
- Should subsidy be provided directly (to customer) or indirectly (through constructor)?
- Which part of the carbon revenues is to be 'returned' to the customers?

Level of subsidy

We propose a subsidy of 30% of the construction investment cost to be reimbursed to the farmer. The remaining 70% will be borne by the farmer/owner of the plant. A flat subsidy rate in percentage (%) of the construction cost is proposed, rather than a flat amount in CFA, due to large variations in the cost within Provinces in the country.

It is anticipated that this relatively higher level of subsidy will result in significant demand, especially in the context of Cameroon where the plant costs are relatively high and micro-credit facilities have not yet been fully accessible to the rural poor.

The Programme anticipates that the country will get returns from the investments not only in environmental and social benefits, but also through possible carbon revenue from biogas plants on the voluntary market which could be around $400 over the plant life of 20 years, based on methodologies that are currently being developed (Uganda Feasibility Study, 2007).

7.3 CREDIT FACILITIES

Another important tool to offset high investment cost of biogas plant is to offer the farmers the services of affordable micro-credit facilities. Local Cooperatives and micro-finance institutions (MFIs) normally are able to provide these services. Those are locally based, have knowledge of the local population are more able to win the trust of the farmers as well as to assess the abilities of the farmers to return the amount i.e. creditworthiness. If the local MFIs are well managed, the interest rates that they can offer can also be lower due to reduced overhead charges.

In designing credit arrangements, it is important for its sustainability purposes that credit arrangements are attractive to both the farmer and the MFI. In doing so, the following considerations need to be made (Proceedings of Bangkok Workshop, SNV, 2008):

- How effective will credit be in meeting Programme objectives?
- What are the suitable terms and conditions for credits for Cameroonian farmers?
- Is credit that will be available attractive to the poor?
- Are all prospective customers willing and able to apply for credit?
- How profitable is biogas credit for banks and MFIs?
- Should credit always be provided on commercial terms and conditions?
- Shall the credit be subsidized directly (to the customer) or indirectly (to the provider)?

The Programme will approach potential credit organizations in Cameroon to assess possible arrangements to provide credit to potential biogas users. For this purpose, the following approach would be taken:

a. Consider history of the farmer to assess repayment capacity: The Households that has been purchasing fuel (LPG, kerosene or even firewood) for cooking is more likely to appreciate the immediate financial benefits from the savings on fuel costs that the family which collects firewood. An average Cameroonian family spends CFA 15,000 to 20,000 per month if using LPG, and much less (around CFA 5,000 if buying firewood. The

approach would be to prioritise a family using LPG as that will be more willing to repay the loans from the savings from LPG expenditure. This can then be extended to other farmers with lower expenditure brackets.

b. Approach Local CBOs or Organizations first to arrange credit: The Programme will prioritize, and work closely with women's self help and savings groups or local farmers' groups to explore if, with capacity building support, they can function as local MFIs to provide biogas credit for their members or community households. These groups will be more affordable, trusted and effective in organizing or arranging credit in more attractive terms and conditions than any external parties.

c. Establish biogas revolving loan Fund to provide wholesale for MFIs

If existing MFIs or suitable arrangements are not yet in place, it may still be possible and cost-effective to establish a revolving wholesale biogas credit fund to provide wholesale loans to potential MFIs at low interest rates. These MFIs can then lend to farmers for the construction of biogas plants at reasonable rates (Winrock International, 2007).

7.4 LESSONS LEARNT FROM OTHER COUNTRIES

A number of countries have been using the financial tools for some years and have acquired valuable experience which Cameroon can bring to good use. The sections below are extracted from the proceedings of the *International Workshop on Financing of Domestic Biogas Plants, SNV, 2008*.

7.4.1 Nepal

The following are some of the major lessons learned:

- Targeted credit fund is helpful in promotion;
- Geographically differentiated subsidy is an effective approach;
- Topping up of grants/subsidies increases promotion but also creates market distortion;
- Access to financial services in appropriate terms for farmers contributes to promotion;
- Loan product designed based on household cash flow ensures loan repayment;
- Biogas is profitable business for MFIs.

The recommendations are made based upon the experience from Nepal biogas programme:

- Ensure continuity of subsidy for poor and remote areas;
- Provide additional subsidy for low penetration districts and village development
- committees;
- Streamline topping up of grants/subsidies into one-window system at district
- development committee level;
- Promote close working relationships between biogas companies and financial institutions;
- There is need to bundling of credit with income-earning activities (biogas plus approach)
- Inflation-adjusted subsidy schemes should be introduced;

- There is need to reach subsidy and credit facilities to poorer households in the remote
- areas. Promote collateral-free loan to reach the poor;
- Link credit to insurance schemes to mitigate risk and motivate borrowers/lenders.

7.4.2 India

- In India, the cost of domestic biogas plants designed for 40 days HRT ranges from US$ 267 for 4 m3 plant (1 m3 gas production/day) to US$ 533 for 10 m3 (4 m3 gas production/day); and that for plants designed for 55 days HRT are US$ 356 and US$ 689 respectively;
- For biogas plants with 40 days HRT, without any investment subsidies, the payback period varies from 4.07 years for 4 m3 plants to 2.45 years for 10 m3 plants; and IRR ranges from 33% to 50%. The payback period and IRR for biogas plants with 55 HRT ranges from 6.17 to 3.36 years and 24% to 38% respectively;
- Subsidy is provided as an incentive to farmers to invest in costly biogas unit to produce clean fuel without destroying manure value of cattle dung;

Present subsidy level on 6 m3 fixed dome plant (2 m3 gas production/day) works out as:

- 17 % of cost for general category
- 22 % of cost for weaker sections
- 46 % of cost for North-Eastern Region States;

Reserve Bank of India lends biogas credit through priority lending programme, NABARD through automatic refinancing scheme, Commercial Banks, Rural Banks, Cooperative banks, Land mortgage Banks and Micro-finance through Self Help Groups are the major financing institutions in biogas sector.

The following are the lending terms and conditions generally set by the financing institutions:

- Composite scheme for dairy/agriculture
- Technical feasibility by biogas staff
- Repayment capacity assessment from other income sources
- Minimum 10 % of cost as farmer's contribution
- Collateral security (cattle/land/gold ornaments and 1 or 2 guarantors)
- No margin money/down payment
- 12 % Rate of interest (0.5 % less for women)
- 3-7 years of repayment period
- Loan amount disbursed in 2-3 installments;

So far, 5,500 plants under the Bagepalli Project, 12,000 plants under Vedaranniyam Project, 10,000 plants under Hassan Project and 10,000 plants under Kolar project have been approved for CDM funds. Likewise 16,000 plants under the framework of Kerala Project have been registered for receiving carbon financing through Chicago Climate Exchange fund.

7.4.3 Rwanda

The major lessons learned till date are:

- The institutional setup took so long trying to separate NDBP & government structure;
- Farmer's in kind contribution is key to the success;
- Subsidy constitutes a great tool in convincing farmers to invest in a new technology;
- As costs of materials go high, it is essential to not define the exact amount the farmer has to contribute;
- FMO – BPR deal took too long at the expense of developing the sector in whole. Due to that the credit system is not yet in place;
- Farmers are eager to take loans to invest in biogas construction, as a matter of fact, though the loan has not yet been launched within the bank; some farmers take other consumption loans to finance the construction of their plant.

Based upon the lessons learn till date the following recommendations are suggested:

- Education & assistance to farmers is necessary to master management of financial facilities;
- Subsidy program could be flexible: subsidy as a % of plant total cost to be updated each year or subsidy expressed in "item – price";
- As methodologies evolve for CDM, we should keep ourselves ahead and maximize the potential benefits;
- Use IT and global connection to Internet to attract investors to invest small amounts in biogas (for instance loans to farmers as Kiva business model);
- Financial instruments for private companies have to be developed;
- Introduction of a loan - insurance for biogas plants.

CHAPTER EIGHT: DEMONSTRATION PHASE ACTIVITIES AND OUTCOMES

8.1 INTRODUCTION

The development of the National Programme included a Demonstration Phase (D-Phase) with the objective of developing around 30 domestic biogas plants to pilot some essential elements of proposed Programme. During the preparatory stage of the Programme development, it was observed that the community members were keen to physically experience the type of technology the Programme would propose as Cameroon did not have the experience of a household level biogas plant at the start of the Programme design. Demonstration Phase would allow testing of some of the biogas elements such as the cost, the acceptability of the technology and digester designs, preliminary impact of the biogas on the household chores for women etc. Similarly, the willingness of the families to contribute to the cost and to perform the tasks needed to run the plant continuously also had to be assessed.

Accordingly, the Demonstration Phase started from middle of August 2009 for a period of four months.

8.2 DESIGN AND APPROACH

In view of the above, the following activities were considered for the Demonstration Phase:

i). Construction of 30 pilot biogas plants to help the farmers visualize and share the experience on the potential benefits from the use of biogas plants.

ii) Undertake a series of sensitisation and awareness development activities.

The selection of the communities (i.e. settlements) and the specific households where the piloting will take place was carried out following a survey process based on agreed described below.

The pilot biogas construction was implemented in such a manner that it reflected the likely arrangements for future biogas development in the country. For this, the following approach was considered:

a. The family selected for the pilot works meets the required conditions (land, access to animal dung, water etc) for sustainable use of the biogas energy.
b. The household commits to provide physical support (financial, labour contribution etc) to the construction of biogas plant.
c. The household agrees to provide *limited cash contribution* of CFA 100,000 as registration fee for inclusion on the pilot phase.
d. The household agrees to use and maintain the plant in a manner recommended by the biogas programme.

e. The household will support to promote the biogas by allowing visitors to the plant site and explain the experience to the visitors.

It was important that the owners of the pilot biogas plants agree to *all* of these criteria.

To support the demonstration phase activities, the SNV Cameroon agreed to and provided the families with contributions in the following items:

- Skilled labour
- Ten bags of cement
- Two lengths of GI pipe
- All pipe fittings

In order that the pilot plant construction process contributes to the promotion of the biogas through practical experience of the new biogas users, the biogas construction and use is to be well documented. This included the following activities:

a. Record of the materials and labour quantity used in the construction.
b. The type of design and specifications of construction materials used in the pilot work.
c. Video footages of the construction process.
d. Development of awareness materials (e.g. brochures, pamphlets, posters) and documentary of the construction process and use of the plants.

The design of the pilot plants explored possible variations in design of the plants and types of construction materials (clay, brick, combined brick/stone etc) used so that it would contribute to research and development in lowering the costs and improving efficiency of the digesters and appliances.

8.3 DEMONSTRATION-PHASE ACTIVITIES

a. Training of masons and technicians

In order to build capacity to carry out future supervision and construction works, 28 masons selected across the country were trained in Rey Bouba in North Province and Santa in the North West Province where the biogas plants were being constructed on pilot basis.

Out of the 28 trainees, 23 were found to be suitably skilled after the training to carry out the works delivering required level of quality.

Following the training programme, the masons have been engaged in the construction of biogas plants in the North-West, Far North and the North Provinces of the country.

The following masons were trained, assessed for their understanding and certification provided for their eligibility to undertake biogas construction works:

b. Status of demonstration domestic biogas plants

The pilot biogas plants built have been located in the following households across the country:

Plant No.	Region	*Village*	Name of the Household	Digester Size (cum)	Feed Type	Status as of 10th Jan 2010	Remarks
1.	North West	Babanki	Youssoufo Dan Poulo	8	Cow dung	100%	Cooking and lighting
2		Medankwe	Nditah Augustine	6	Cow dung and pig	100%	Cooking since early Jan 2010.
3		Bamendankwe	Peter Tanze	8	Cow and pig	90%	Drain pit and feeding remaining.
4		Bamendankwe	Shu Robert	8	Cow dung	90%	Drain pit and feeding remaining.
5		Bamendankwe	Achiri Christopher	6	Cow dung	100%	Cooking since Dec 2010.
6		Santa	Denis and Filisa Asanji	6	Cow dung	100%	First family. Started using from 3 Nov 2009.
7		Santa	Dewa Anye Jonathan	6	Cow dung	100%	Functioning. Not yet cooking. House transfer awaited.
8		Santa	Nkwenti Godfrey Tuman Jong	6	Pig	100%	Cooking since Dec 09
9		Santa	Tuma Jong Joseph Chi	8	Cow dung	100%	Cooking since Dec 09
10		Santa	Chefor Samuel	8	Cow dung	90%	Digester complete. No feeding yet.
11		Santa	Yanye Paul	6	Cow dung	90%	Feeding started
12		Santa	Joe Lobizi Akunfongwe	10	Pig	95%	All complete. Ready for gas production.

13		Santa	Tembong Florence	8	Pig	75%	Internal dome work, pipe fitting and feeding.
14	North Province	Rey Bouba	Lamidou Rey Bouba	10	Cow dung	100%	Cooking started from Dec 09
15		Rey Bouba	Djaoro Babba	6	Cow dung	100%	Cooking started from Dec 09
16		Rey Bouba	Moussa Tonga	6	Cow dung	100%	Cooking started from Dec 09
17		Rey Bouba	Dewa M	6	Cow dung	90%	Feeding remaining
18		Figuil	Singai Kangou Celestin	10	Cow dung	90%	Feeding on-going
19		Figuil	Oumaru Bouba Tchede	6	Cow dung	90%	Feeding on-going
20	Extreme North	Maroua	Hamadou Ahmadou	8	Cow dung	90%	Feeding on-going
21		Maroua	Baba Oumarou	6	Cow dung	100%	Started cooking from Dec 09
22		Maroua	Ouamrou Lawal	8	Cow dung	50%	To be updated
23		Kousseri	Hassana Issa	8	Cow dung	40%	To be updated. Gravel and sand unavailable readily

c. Preparation of the audio-visual materials

During the course of the pilot biogas plant construction, a series of photographs of the construction work, interviews with the owners of the plants and records of the procedures and quantities of materials used have been recorded. These data and information is used in the design of the fully-fledged National Programme.

In early January, a team from the Communications Section of the Ministry of Energy and Water Resources (MINEE) visited the pilot biogas families and took the footages of the biogas plant construction processes, impressions of the owners of the plants and of those who were already using the biogas for their domestic cooking. The resulting documentary is going to be used to bring wider awareness at the national level among the government stakeholders as well as rural communities through the use of mass media.

8.4 PRELIMINARY FINDINGS AND IMPRESSIONS

As discussed above, the pilot plants developed have been very useful in providing indications for the wider development of biogas in the country. Some of the findings and impressions from the field and interactions with the users of the biogas plants can be summarised as follows:

a) Appropriateness of design

The design used at the pilot phase is the fixed dome type, GGC 2047, that is widely used in Nepal and other countries in Asia. This design essentially consists of a concrete dome over stone or brick walled digester body and is common for sizes varying from 4 cubic metres to 15 cubic metres, the most common being 6 and 8 cubic metres for an average sized families owning 4 to 10 cattle. While higher cost is often associated with the design of this type, it is nonetheless attributed with having a long structural life of 20 years or more with minimum maintenance on the constructed parts as compared to pipe and fitting works.

The experience in the pilot households showed that the local population were familiar with the materials used in the construction works, the local masons quickly learnt the skills and most of the construction materials, particularly the sand and gravel, were locally and easily available. The digester therefore appeared to be quickly acceptable and familiar item for the households.

b) Cost of the biogas plant

The cost for the biogas plant varied from area to area depending on its accessibility, sourcing of the materials and the timing of the construction owing to the volatility of the market which affected the price of the cement and fitting materials. However, it was possible to develop some indicative pricing structure for different regions, and is summarised below for indicative purposes:

Region	**Digester Capacity**	**Cost sharing (%)**				**Total (CFA)**
		Household	**%**	**SNV/ HEIFER**	**%**	
Rey Bouba	10m3	439 215	67	212 843	33	652 058
	6m3	380 820	71	154 838	29	535 658
Figuil	10m3	402 820	76	127 075	24	529 895
	8m3	391 000	78	108 798	22	499 798
	8m3	406 220	67	200 938	33	607 158
Maroua	6m3	359 820	78	108 798	22	499 798
Kousseri	6m3	399 560	74	139 482	26	539 042
North West	10m3	427 832	76	138 368	24	566 200
	8m3	416 220	81	100 530	19	516 750
	6m3	386 170	83	79 755	17	465 925

Briefly, the average cost of developing a single biogas plant (standard 8 cum sized) comes to as follows:

North West Province: CFA 5,50,000.

Far North Province: CFA 6,50,000.

These costs are only for the construction materials and associated unskilled and skilled labour. These exclude supervision and monitoring/quality control costs of any kind.

c) Impressions of the biogas users

A series of visits was made in early January 2010 to the users of the domestic biogas who had their plants up and running for some weeks. This included a family of Filisa and Denis Asanji and their 3 young children, who have become the first family in Cameroon to use domestic biogas to cook food at household level. They have been doing so since 3rd November 2009 when they first started to get full and uninterrupted supply of biogas from their digester of 8 cubic metres. Since then, they have been continually using their biogas supply to cook their everyday meals.

The impressions derived from the users of the biogas can be briefly summarised as follows:

a. The cooking activity has been a lot easier, saving on the time to access or buy firewood and the actual cooking process.
b. The absence of smoke in the kitchen has been very welcome.
c. The wasted animal dung is giving the gas which would have otherwise been wasted.
d. The slurry is now nearby and will be used for the farming and to grown vegetables.
e. We are happy that our forests will be saved as finding firewood is getting very difficult
f. The cost of the plant is not very high (with subsidies).
g. The plants should be providing to neighbours and to as many people as possible.
h. This is very amazing to us and we are very thankful to those helping us to have this technology.

While environmental impacts of the biogas use, particularly in the context of the climate change is not expected to be evident to the common users, the first and most notable impression was on not having to spend time or money for firewood. This was the case in all the Provinces of the country irrespective of their forest coverage areas.

d) Demonstration effect

Currently, only 23 biogas plants could be supported for piloting works mainly due to lack of funds at the SNV and governmental level to subsidize the households. The households that are interested to contribute CFA 100,000 and register to own a biogas plant has been increasing with the demand being made by the families in and around the villages where demonstration plants have been built.

The existing owners of the biogas plants have reported that their neighbours, relatives and curious visitors have been dropping in every day to see the new addition within their locality. The biogas households have become proud owners of a technology which the

visitors find very new, exciting, sometimes disbelieved and desirable to those who have seen it. From experience, it is now widely known that biogas has a higher impact when it is actually seen with the flaring flames than simply being mentioned about, and similar has been the experience of the new biogas users in Cameroon where the pouring visitors have sought more information on the cost and the way to access the plants.

8.5 LESSONS LEARNT

A number of useful lessons can be drawn and recommendations to feed to be Programme design process can be made from the experience of the demonstration phase activities. These include:

a. Variations in design

Cameroon has interesting geological variations. For example, most of the area on North West Province is characterised by hard laterite based soil with good stability for cutting up to 2-3 metres. While this is not the case for other regions, this attribute can be used cost of cement work by limiting use of cement blocks of bricks and replacing these with simple cement mortar. Similarly, there exists possibilities for bamboo based digester and dome development that is being explored in Nepal. With Cameroon having abundant bamboo plantations, this could be a cost-effective option. These possibilities will need to be tested within a research and development (R&D) environment at a later stage as this will require a number of trials before they can be reliably replicated.

Similarly, demonstration phase has shown that the following variations exist in feeding quantities and gas output for different Regions in the country:

S. No.	Region	Weather characteristics	Animal dung feeding (kg)	Remarks
1	Extreme North	Generally warm to hot climate throughout the year.	Feeding is around 7.5kg per cum size of the plant.	Other characteristics (e.g. use of water, types of feed materials) are same
2	North	Generally warm to hot climate throughout the year.	Feeding is around 7.5kg per cum size of the plant.	As above.
3	North West	Generally cool and moist climate for most time of the year.	Feeding is low feeding around 6kg per cum size of the plant.	As above.

b. Use of slurry as compost

Slurry is often seen as a bi-product of a biogas plant whereas it has a economic and environmental value almost equal to that of biogas. The experience so far has shown that composting is not yet a common practice, and with agriculture extension services added to the biogas programme, this can potentially be a significant attraction to the families. There is already a growing and viable commercial vegetable production market in Cameroon.

c. Biogas for lighting purposes

Electricity from conventional sources is still unavailable to majority of the rural Cameroonian households. Even where available, the quality is poor due to low voltage or load-shedding due to inadequate production. As a result, households in those poor service areas were keen to avail lighting benefits from the biogas. Demonstration of potential lighting appliances is included in selected households and this could lead to wider adoption of biogas by the households.

d. Cost and quality control

After the availability of animal waste, cost will continue to be the primary factor in decision making for the ownership of biogas plants. Primary indications from the demonstration phase showed that the message on costs have not been consistent, mainly due to opaque and profiteering procurement process by local biogas promoters. As a result, quoted costs have varied widely which could confuse the farmers. Similarly, quality control practices have not been very rigid, with some cultural practices established from local house building being applied to the bio-digester construction as well. As a result, presence of dirt in the concrete or absence of regular and adequate curing was noted in some plants. This could have significant and damaging impact on the quality. A quality control system that establishes new level of quality for the biogas will need to be designed and applied for biogas plants.

e. Sustained dissemination

With the development of nearly 2 dozens of biogas plants across the country, the process of developing biogas plants in Cameroon has begun. In order to continue the momentum and keep the skilled resources engaged, additional plants need to be built continuously. More experience will be gained with the materials and technology, as has been done within the brief period of four months, in establishing appropriate centres for appliance production and testing. Similarly, with the experience of new users, the message of the benefits and possible demonstration visits need to be arranged to communicate them to much wider audience at the national level.

e. Material requirement variations for different designs:

Due to the remoteness of some regions in the country and the geological variations associated with them, the biogas construction cost variations are significant. The table below summarises such variations.

Table: Illustration on variation in Cement bags consumed for different regions

Plant size/ Variants	**10 cum**	**8 cum**	**6 cum**	**Remarks**
Stone wall	27	NA	20	
Cement solid block wall	35	NA	27	
North West	33	30	27	Experience of Santa
North	35	33	30	Experience of Figuil and Rey Bouba*
Extreme North	Not experimented	33	30	Experience of Maroua

Rey Bouba area has a possibility of water logging due to high water table. For low lying households, additional 2 bags of cement may be required for additional water proofing qualities.

8.6 SPECIFIC RECOMMENDATIONS

In view of the above findings and lessons learnt, some specific recommendations on the way forward for the national programme design can be made as follows:

1. The GGC 2047 design along with country-specific alternations shall be appropriate and considered for the plants under the national programme. The alterations shall be researched and gradually incorporated into the design over the course of the programme implementation period.
2. The availability of construction material is scarce in the North and Extreme North Regions. Labour is also not readily available in those regions, as a result, a different modus operandi for implementation, summarized as below, is recommended.

S. No.	**Region**	**Availability of construction material**	**Availability of household labour**	**Access to animal dung**	**Proposed implementation modality**
1	North	Gravel and sand generally available.	Household labour is limited, delay in construction by household	Cattle abundant, but difficult to access dung due to pastoral practices.	Both materials and labour to be fully contracted out.

2	Extreme North	Gravel scarce and expensive.	Limited labour inputs from the households.	Cattle abundant, but difficult to access dung due to pastoral practices.	Both materials and labour to be fully contracted out.
3	North West	Both sand and gravel generally available.	Quick labour provision by households.	Cattle under generally zero-grazing practices. Dung readily available.	Labour provision can be put into the option for the families.

Note: These 3 Regions represent areas where demonstration phase plants were developed.

3. It is recommended that the procurement of non-local materials (such as pipes and pipe fittings, appliances etc) be carried out centrally on a competitive basis for the whole annual programme in the Transitional Year (i.e. YR1 of the Programme).

CHAPTER NINE: THE TECHNOLOGY AND CHOICE OF DIGESTER MODEL

9.1 INTRODUCTION

Biogas is produced as a result of microorganism activity When any organic matter, such as cow dung, crop residue and kitchen wastes is fermented in the absence of oxygen. This gas essentially contains combustible methane (around 60%) along with carbon dioxide (30-40%), and traces of other gases. Biogas is colorless and odorless and serves as a convenient fuel that can be used for a variety of applications such as cooking and lighting at the household level. The spent waste (called slurry) that comes out of the biogas plant after the gas is produced is an excellent organic manure to improve soil fertility.

9.2 DIFFERENT MODELS

Understandably, there are a range of ways biogas can be produced. The choice of the most appropriate technology depends on the geography, ability to pay and many other factors. In brief, when seeking to make a choice, the following considerations are important: (i) the durability (ii) the effectiveness (iii) amount of gas produced and gas storage capacity of the dome, (iv) effect of temperature on composite plant and (v) methods or ease-ness of construction.

Among the large selection of models of plants and their variations, the following are commonly found in different parts of the world:

Fixed Dome Digester (CAMARTEC design)

This is one of the models commonly found in Africa and is known as the CAMARTEC design, named for the government research institute in Arusha, Tanzania where it was first developed. It consists of an underground brick masonry compartment (fermentation chamber) with a dome on the top for gas storage. In this design, the fermentation chamber and gas holder are combined as one unit. Biogas plants with digester volume of 8m3, 12m3 and 16m3 are commonly used for household use. Experience shows that this model is often found to require services of highly skilled masons and take longer to construct.

Floating Drum Digester

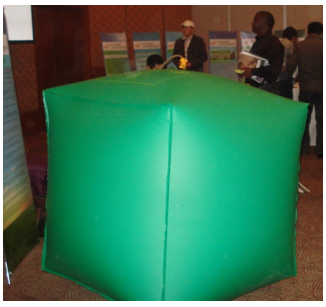
This design consists of a digester chamber that is made of brick masonry in cement mortar while a mild steel drum is placed on top of the digester to collect the biogas produced from the digester. The floating drum plants have now become obsolete due to comparatively high investment and maintenance costs.

Plastic Digester Designs

The Plastic Digester design consists of a digester bag made of thick gauge polythene tube between 0.5 and 1.0 meter in diameter which is placed in a trench. The inlet and outlet are typically made with 4 inch diameter PVC pipes tied at the end of the digester bag with rubber bands from car tubes. Produced gas is collected in a separate reservoir "balloon", also made with a polythene tube. Gas is carried from the digester first to the balloon and then on to the kitchen with half inch PVC plastic pipe. This design is often giving low gas pressure and insufficient brightness of lights. There are also high maintenance cost as the plastic membrane could easily be punctured by sticks or pointed stones and could also be damaged by cows or
other animals.

Drum based design

In the Extreme North Provinces of Cameroon, COPRES SA in collaboration with Belgian and Nigerian technicians built several drum based biogas plants (see photo on the right). These are, however, small and inadequate to cooking even a single meal per day while requiring regular maintenance costs.



Soft biogas reactor

These biogas digesters are manufactured using sophisticated machines by means of welding with Poly Venial Chloride (PVC) that contains more than ten types of aging-resistant, corrosion-resistant, fire-resistant and special additive materials. The capacity of absorbing and storing the ambient heat by this plant is 30% higher than that of other materials.

Puxin Biogas

Shengzhen Puxin Science and Technology Co. Limited, China, produces Puxin biodigesters which claims to have leakage free digester and dome. It is also claimed that the time needed for the installation of Puxin plant is much less and the structural durability of this plant is much higher than conventional plants.

GGC 2047 Model

This fixed dome model developed and widely used in Nepal is now also adopted in other parts of the world with some modifications. This model is considered as the most appropriate model for large scale dissemination due the fact that it has been widely tested in different working conditions and the outputs in terms of gas production, maintenance costs and durability are consistently found within the acceptable limits.

The GGC model is essentially designed to have cattle dung as the primary feeding material. Toilets are attached to increase gas production and to improve local sanitation.

GGC biogas plants are built to a high quality and generally last more than 20 years without major maintenance requirements. The maintenance requirements are mostly associated with pipe works whereas digester maintenance are required only when poor construction is associated or feeding is not carried out properly.

In view of the above benefits, the Programme proposes to use GGC 2047 model for National Biogas Programme with modifications where appropriate.

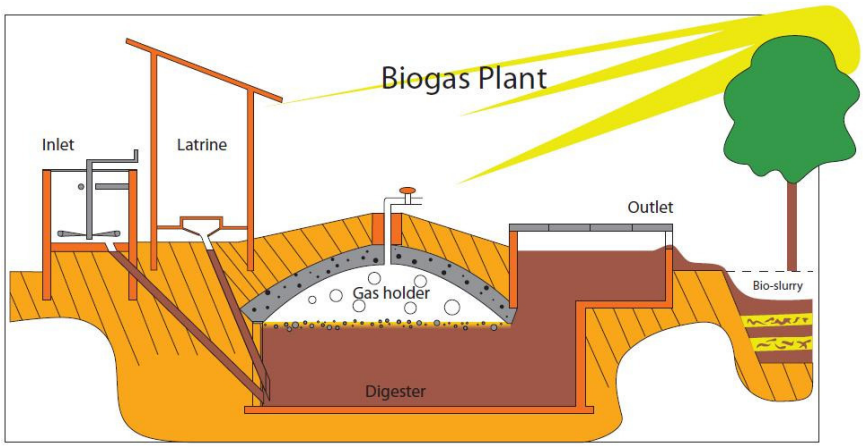
The additional information on this model is provided in the following sections.

9.3 COMPONENTS AND APPLICATION OF GGC 2047 MODEL

9.3.1 Biogas plant components

A biogas plant has the following essential elements:

Digestion Chamber: The digester chamber is where anaerobic reaction or digestion of organic matter by methanogenic bacteria takes place and produces methane gas and other traces as its by-product. The chamber is flat bottomed and is covered with a dome shaped, gas tight concrete gasholder. GGC plants are constructed in sizes of 4, 6, 8, 10, 15 and 20 cubic metres, of which 6 and 8 more widely used by the domestic users.



Inlet: This structure enables organic feed material into the digestion chamber. The inlet is where the dung is deposited and mixed with an equal amount of water resulting in readily digestible semi solid state. The inlet is often equipped with a mixing device to make the mixing process easier for the users and to make the mix more homogenous.

Outlet: The outlet structure helps to remove the digested organic matter, i.e., the Effluent, from the digestion chamber on to the slurry pit. The outlet level is always lower than the inlet level to ensure one-way flow of the digested slurry.

***Dome*:** This is a concrete structure designed to provide maximum storage of gas and constructed as a air tight structure. At its highest point, a pipe is fixed in the concrete dome that pipes the gas to burners for cooking and/or a lantern for lighting. When gas is

consumed, the volume of the gas in the gasholder decreases resulting in the rise of slurry level in the digester and a fall in the outlet. The moment the difference between the two levels is nil, the pressure of the gasholder equals the atmospheric pressure, and will thus stop flowing out. The temperature range inside the digester should be maintained between 30 and 40℃. Optimum production occurs at 35℃.

9.3.2 Frequently Asked Questions

Q. How many cattle do we need for biogas?

We need two healthy, zero-grazing, cattle for the smallest sized plant (i.e. 4 cum). Normally 1 cum biogas plant needs 6 Kg dung, and therefore the 4 cum size plant will require 24 kg feed. One healthy cattle on average produces 12 Kg dung per day.

Q. How do we select the appropriate size of biogas?
The smallest size for domestic biogas is 4 m3 and the largest is 10 m3. The size of the plant is selected primarily taking into consideration the available dung. Only when the feeding material is known, then the actual gas usage is assessed taking the family size, cooking hours, light bulbs etc into the calculations.

Q. What is the life expectancy of a GGC biogas plant?
The biogas plant is constructed like a house is built with high quality materials and care in the construction process. If carefully built, a biogas plant can have a life of 20 years or more in normal circumstances.

Q. What do I do if my biogas plant needs maintenance?
The Cameroon Biogas Programme is designed to support you with the maintenance services. This maintenance will be done by the company that built you the plant for a period within guarantee period. If the biogas plant has any technical problem, farmers are therefore advised to consult the construction company.

Q. How many hours can we cook from biogas?
Cooking hours depends on the size of biogas plant. Normally a 6 cum plant produces about 1400 liters of biogas a day. One stove consumes about 400 liters of gas per hour. At this level, you can burn the stove for approximately 3.5 hours/day.

Q. Is the toilet-attached biogas pure and the slurry safe?
The gas produced from cattle dung and from human excreta are the same in terms of purity and hygiene. The slurry that comes after digestion is also safe but precaution needs to be taken in maintaining proper hygiene. Hands should be washed properly after touching with the slurry. If constructed and maintained properly, all the harmful pathogens are mostly killed in the digestion process.

Q. Does the slurry from the biogas plant have fertilizer value?
The slurry from the digester can be readily used for crops directly or after composing it for some time. It can also be used as feeding materials for fish. Slurry generally provides higher quality fertilizer than farmyard manure. Some studies have shown that composted slurry can increase crop yield rates by up to 30%. The slurry must be stored and applied properly, however, in order to maintain the optimal nutrient level.

9.4 ADVANTAGES OF BIOGAS USE

Sustained use of biogas offers notable positive impacts on family health, socio-economic development of poor families and the protection of natural environment. The use of biogas as replacement of fuelwood for household cooking has helped families to cook in smoke-free environment, saving mothers and children from life-threatening diseases. The family members, particularly women and girl child, are spared of considerable hardship of fuelwood collection, prolonged cooking and cleaning periods which could now be used in income generating and learning activities. Biogas lights can help children and family members to provide light in the evenings, enabling children to focus on their education. The slurry coming out from the digesters is rich in nutrients and freed from harmful weeds and micro-organisms. Biogas has recently been increasingly used in different parts of the world for refrigeration, generation of household electricity, pumping of water for irrigation purposes and many other household and industrial activities.

Environmental benefits

The environmental benefits of using biogas are equally attractive. An average rural Cameroonian family switching from conventional fuelwood based cooking to biogas can help to save nearly 3 tons (MT) of firewood in a year. The conservation impact on national forest resources of thousands of families making this change can be enormous. At regional and international level, use of biogas helps to reduce Greenhouse Gas (GHG) emissions to the atmosphere. The collection of animal waste and non-renewable biomass (NRB); their digestion in the bio-digester; and eventual burning in the kitchen of the collected methane gas means that the methane gas which would otherwise have been released into the atmosphere is mostly tapped in a controlled environment and burnt off without any adverse impacts.

Methane is considered by scientific community (source: Earth Report, BBC, 2007) to be nearly 20 times more potent GHG than common baseline GHG Carbon Dioxide (CO2). Use of large number of bio-digesters can make appreciable impact on reducing GHG emissions and therefore favourably affect the climate change process. A number of studies are being undertaken in Nepal, India, Laos and other countries to estimate the level of methane gas savings made due to use of biogas digesters. The studies in Nepal suggest that an average biogas plant helps to reduce methane emissions by as much as 4.98 TCO2 equivalent (source BSP Nepal). For comparison purposes, studies have suggested that an average family car in the US emits around 10 T CO2 into the atmosphere in a year.

Other benefits

The benefits of biogas in energy supply, agriculture, health, sanitation, gender and environment are well documented. There are a number of aspects of biogas production that have multiple benefits:

Animal dung and night soil is collected regularly and fed into the biogas plant, this:

- reduces pollution: leading to a cleaner farm environment;
- reduces human and animal disease: by improving sanitary conditions related to bad sanitation and polluted surface water for both the household its environment,

and;

- reduces greenhouse gas emissions: depending on the traditional manure handling, the improved manure management system can significantly reduce GHG emissions.

The generated gas substitutes conventional fuels. In doing so, biogas:

- reduces indoor air pollution: the incomplete combustion of conventional fuels is minimized, resulting in a reduction of eye and respiratory illnesses particularly of those most heavily exposed to smoke namely women and children;
- reduces workload: especially in regards to fetching firewood, maintaining the fire and cleaning cooking pots. The use of biogas can reduce workload by 2 to 3 hours per day, particularly the workload of women and children;
- reduces fuel expenses: traditional domestic fuels increasingly become part of the formal economy. Biogas significantly decreases consumption of these traditional sources;
- increases opportunities to use appliances: such as gas lamps and water heaters;
- reduces greenhouse gas emissions emitted by the conventional energy sources;
- reduces deforestation: by reducing the demand for firewood;
- provides income generation opportunities: by providing an energy source activities (incubators, kilns, lanterns etc) as a new or more efficient resource.

The residue of the process - bio-slurry-, is a potent organic fertilizer. When used in this way it can:

- provide a superior organic fertilizer: in terms of available nutrients and soil texture, increasing agricultural yields with 20-40%.
- provide a catalyser for composting other agricultural waste: Applying this practice increases the amount and quality of organic fertilizer;
- improve handling safety: of residue due to the fact that the process of digestion followed by composting makes handling of the residue much safer from a hygienic point of view;
- reduce chemical fertilizer costs of farmers: by reducing the amount of synthetic fertilizer used;
- reduce greenhouse gas emissions through avoiding the application of synthetic fertiliser
- enables farmers to participate in animal husbandry in areas in which discharge regulations would otherwise have been prohibitive: anaerobic digestion reduces odour and environmental load resulting from livestock holding.

ANNEX

ANNEX 1: PERSONS MET

DR. NGNIKAM TO ADD MORE NAMES OF THE PERSONS WE TOGETHER MET.

Asanji Nelson	Cellule de Maitrise de l'Electricite, MINEE. 77394185. che7nelson@yahoo.com
Mr. NGUESSEU Andre	S/Director Plannification de la Production de l'Electricite. 99766372. ngues2001@yahoo.fr
NKECK Edouard	Sous-Director de la Maitrice de l'Energie. 22222098. 7772 9832/ 9654 0488. ednkeck@hotmail.com
GHONNANG Jean Pierre	Director, Department of Energy, MINEE
Dr. Ebode Sylvain Blaise,	Director, Ministry of Livestock, Fishery and Animal Industry, MINEPIA.
Mme Booto	Project Coordinator, Milk Production Programme (with Heifer International)
H.E. Abakar Ahamat	Governor, North West Province, Cameroon.

ANNEX 2: REFERENCE DOCUMENTS AND MATERIALS

Shuva to build the list and send in final version

ANNEX 3: EVALUATION OF INITIAL TWO BATCHES OF TRAINEES

S. No.	Name	*Score*	Capabilities	Remarks
A.	***TRAINING IN SANTA, NORTHWEST***			
1	Tantoh John NDI	A+	Good Supervisor and Mason	
2	Diense Eric Yuah	A++	Very good Supervisor. Innovative and proactive	The best trainee output. Good in coordination and management
3	Nyuydzele Abel	A+	Good Supervisor and excellent Mason	Empolyee of another organisation. Will need incentive to join biogas team.
4.	Dewa Anye Jonathan	B	Cannot lead and supervise. Not good as Mason	Can perform as support Mason.
5.	Babila Georges	A	A good Mason. Cannot supervise	Not very motivated. Can perform under good supervision.
6	Goneh Noah Vitoff	A	A good Mason. Cannot supervise	Not very motivated. Can perform under good supervision.
7.	Tumetoh Joseph	A	A good Mason. Cannot supervise	Not very motivated. Can perform under good supervision.
8.	Eric Saamoh	A	A good Mason. Cannot supervise	Not very motivated. Can perform under good supervision.
9.	Fru John Fube	A	Can supervise.	He is busy in private works. Can start biogas contracting
10.	Achiri Christopher	A	A good Supervisor with excellent capabilities.	He is a potential biogas Contractor. Not willing to put in hard work.
11	Genjang Akosung Joseph	A	A mature Supervisor with capabilities.	A reliable person to lead a team.
12	Tangwa Douglas	A+	A talented person suitable for Supervisor or Mason	
13	Rinskylne Lovelyne Tanwani	A	Good in interacting with families. Can be a good Supervisor	She can do good in promotional activities for the Biogas Programme.

B.	TRAINING IN REBUBA, NORTH AND EXTREME NORTH PARTICIPANTS			
1.	Oumar Abouama	Fail		Kousseri
2	Kadiri Moussa	A	A good Mason only.	Kousseri
3	Boukar Afaka	Fail		Kousseri
4	Charte Hessana	Fail		Kousseri
5	Hamadou Baba	Fail		Maroua
6	Souleymanou Issa	A	A good Mason only.	Maroua
7	Hamadou Dzika Oumarou	A	A good Mason only.	Kousseri
8	Duffissa Mabanga	A	An good Mason and Supervisor. Can be useful.	Figuil
9	Saidu Moussa	A	A good Mason only.	Rey Bouba
10	Housseni Nkuh	A+	An experienced Mason and Supervisor.	Rey Bouba
11	Dairou Bakari	A	A good Mason	Rey Bouba
12	Sande Paul	B	Can work as Mason but is not proactive	Rey Bouba
13	Betolum Manas	Fail		Rey Bouba
14	Mohamadou Ousman lla	A	Good mason but has to be supervised.	Rey Bouba
15	Oussenie Barbang	A	Good Mason but cannot supervise	Rey Bouba