INSTITUT DE RECHERCHE EN SCIENCES APPLIQUEES ET TECHNOLOGIE (IRSAT)

CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE ET TECHNOLOGIQUE (CNRST)

Dissemination of improved stoves and biogas experiences in Burkina Faso

Dr. Oumar SANOGO

Senior researcher / Chief of Energy Department

South-South cooperation in the field of Biomass energy
Challenge and opportunities
2IE - Ouagadougou, Burkina Faso

Monday 1 – Friday 5 December 2008

Plan

1. **Dissemination of improved stoves in BF**
   - History
   - Stove surveys
   - Stove development
   - Training
   - Quality control
2. **biogas experiences in Burkina Faso**
   - History
   - Technologies
   - Lessons learned
   - Route to B4BL

1. Dissemination of improved stoves in BF

- Some Facts :

  - In 2007 each burkinabé consumed about 240 kilogramme equivalent oil of energy.
  - Wood and charcoal represents more than 84 % of the primary energy.
  - more than 80% of Burkinabé especially in rural area rely on wood and charcoal to meet their energy need specialy for cooking.
  - The forest represent only 29% of the national territory
  - From 1990 to 2005 the forest area variation has been – 0,3 % per year

Wood supply is a key issue at national level and is of high priority.

History

- From the study on energy conducted by CILSS and the Club du Sahel in 1978 it has appeared that « wood represents 60 to 90% in the energy balance of sahelian countries »
- Any development strategy in this region should take into account this important fact.
  - The Recommandations from this study were :
    - there should be an improvement of the « open fire stove » which use only 3 to 8% of heat produced by firewood.
    - Every sahelian country should create a structure to :
      - » Investigate the best ways to promote improved stoves
      - » Organise large diffusion of improve stoves

In Burkina MET : Coordination of improve stoves diffusion. (1981)

History

- From this moment to the creation of the minitry of Energy in 19995, the MET worked very closely with IRSAT to :
  1. To conduct a survey and evaluate existing stove
  2. Develop improve stoves
  3. To train stove producers
  4. Control the quality of stoves

Survey of existing stove

Household stoves

3 Stones Traditionnal (3PT)

Malgachian

Thermal efficiency < 15 %

Institutionnal stoves

Dolo stoves (regional designs)

Thermal efficiency # 18 %

0,3 kg of wood / liter of dolo brewed

Improved Stove Development

Household stoves

3PA

mud, cow dungs straws

Single pot uses wood

-

selfconstruction

Ouaga Métallique

Metal sheet

Sigle pot uses wood

N°2 : $3

N°3 :$4

N°4 : $5

Commercial

Burkina Mixte

Metal sheet

Single pot uses wood and charcoal

N°2 : $4

N°3 : $5

N°4 : $6

Commercial

Multimarmite

Metal Sheet

Multi pots use wood and charcoal

$4

Model mali : $5

commercial

Improved Stove Development

Household stoves

3PA

Ouaga Métallique

Burkina Mixte

Multimarmite

Energy savings in comparison to 3 stones stoves

3PA	Ouaga Métallique			Burkina Mixte			Multimarmite		
	Riz-sauce	Riz-gras	Tô	Riz-sauce	Riz-gras	Tô	Riz-sauce	Riz-gras	Tô
	-40%	-47%	-41%	-38%	-36%	-32%	-24%	-35%	-27%
-39%	**-43%**			**-35%**			**-29%**		

Improved Stove Development

Institutionnal stoves

- Constructed in mud with several pots on the same fireplace
- Change the material of the pots from clay to aluminum
- Energy saving = - 60%

Improved Stove Development

Institutionnal stoves

- Research still continuing on Dolo brewing with butane burner stove

Improved Stove Development

Technologies transfert

- Rockets stoves:
  - Adaptation to local pots and local cooking habits
  - Testing (lab)
  - Acceptability Test (households)

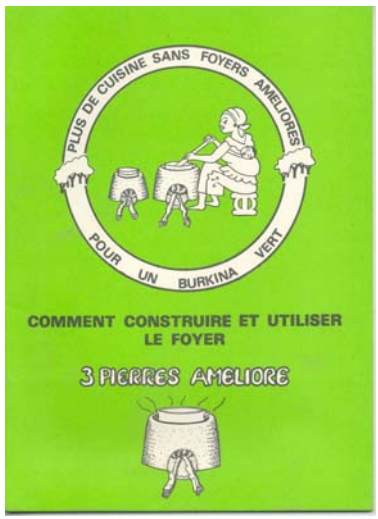
training

1 – training of trainers

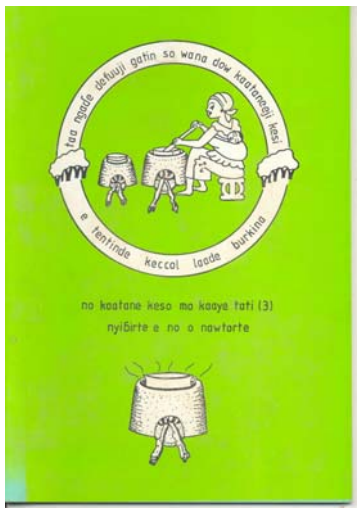
- Artisans
- Vulgarization agents
- Women associations

2 – Development of Didactics materials

- Production of stove template for artisan
- Stove construction manual in national languages



French



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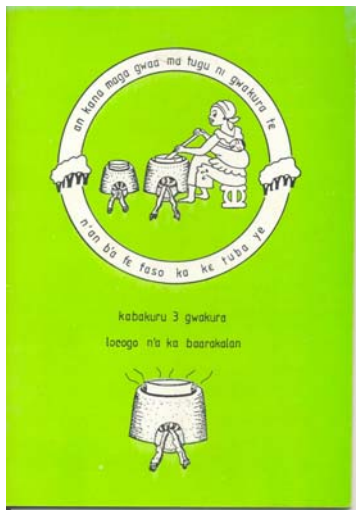

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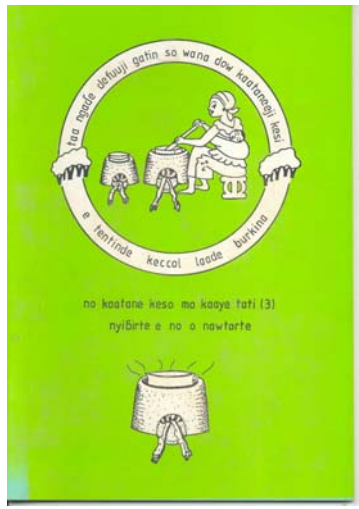


Fulfuldé

Quality Control

1 – quality control of existing stoves

- Kerosen stove : RPTES
- Institutionnal stoves : Group TOTAL-BF, SODIGAZ
- Technologies produced by inventors

2 – Stove production by artisans and labelling

IBE (IRSAT) Label

Roumdé Label (IRSAT-GTZ)

2. Biogas experience in Burkina Faso

History

- biogas prototypes have been installed in BF since mid- 1970, promoted mainly by three organisations:
  - Comité Interafricain d'Études Hydrauliques (CIEH) in collaboration with the Institut de Recherche Agronomique Tropicale (IRAT) ;
  - Association Internationale du Développement Rural (AIDR) from Belgium ;
  - Institut de Recherche en Sciences Appliquées et Technologies (IRSAT), former Institut Burkinabé de l'Energie (IBE).

History

- The work undertaken by the CIEH and the IRAT consisted in adapting biogas technology to the conditions of the sudano-sahelian countryside characterized by:
  - low availability of water.
  - weak integration of agriculture and livestock,
  - availability of primarily straw substrates,

- In 1976 CIEH and IRAT started a research and experimentation program on the valorisation of organic waste by producing compost and biogas.

- This program completed 3 phases, financed by the Commissariat de l'Energie Solaire (COMES), aiming at :
  - defining the technology,
  - designing and developing prototypes of digester to prepare a dissemination programme.

- 1979, a first household biogas unit was designed and installed for experimentation by CIEH in Boulbi - Centre d'Entraînement à la Culture Attelée -

History

- From 1978 on, AIDR designed and installed biogas plants in Kongoussi and Goundi, with financial support of the Fonds Européen de développement (FED)

History

- Within the framework of the GTZ «Programme Special Énergie», IRSAT installed biogas units in several locations :

  Farakobâ, Koudougou, Gaoua, Fada, Pô, Ziniaré, Pabré, Matourkou, Boromo, Tenkodogo, Yako, Kamboinsé, Kombissiri, Bogandé, Diébougou, Banfora, Polgo, Ouagadougou, Saaba, Zorgho

History

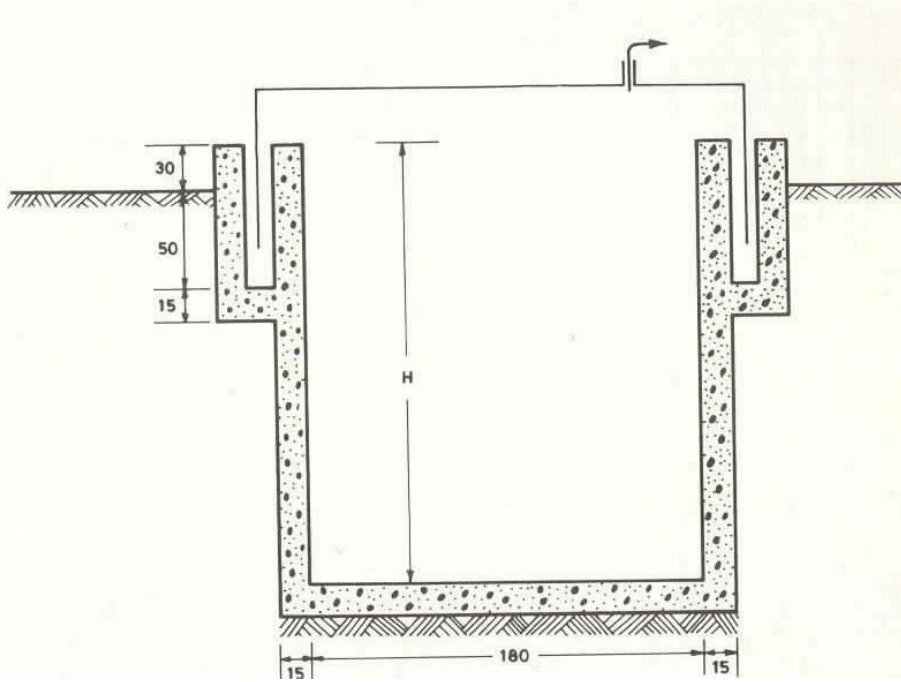
- In the mid-80ies, the Government launched the «*Programme Populaire de Développement*» *(1984-1987)*. One of the objectives of this program was to supply all 30 provinces with biogas plants. During this period, IRSAT realised several biogas units in :
  - health centres to use the gas mainly for the sterilisation of medical instruments.
  - Military barracks for cooking
  - Schools for cooking and lighting.

biogas technologies introduced in Burkina Faso

- By year 1982, several fermentation batch digester prototypes (based on the Algerian type) were developed and installed in CIEH and in the agronomic research centre of Saria

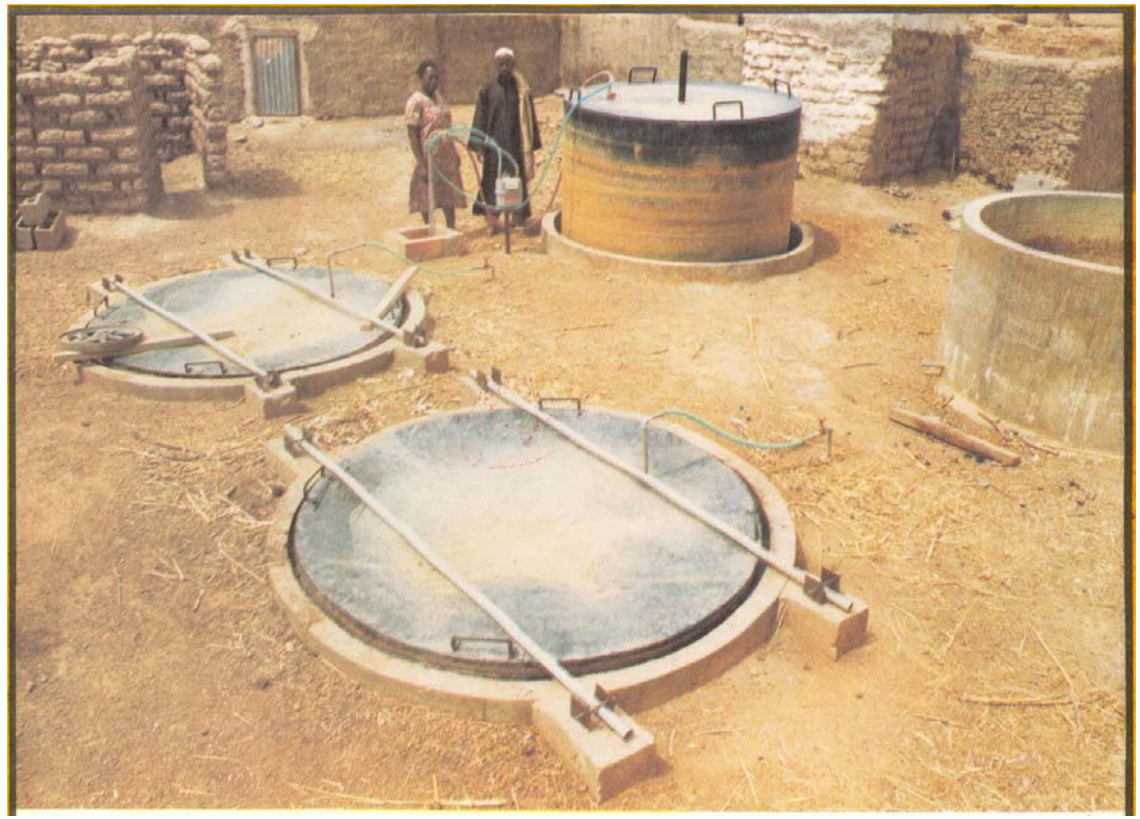
biogas technologies introduced in Burkina Faso

These experimental digesters consisted of wells with walls of some 10 cm thickness of compacted reinforced concrete. At the upper part, two concentric circles spare a water seal in which a metallic lid is inserted. The lid, made of 3 mm thick metal sheets has a cylindrical form. It serves as gas storage, and could contain the gas production of 2 days, i.e. 2 m^3 of gas from a digester of 4 m^3.



biogas technologies introduced in Burkina Faso

These experimental combined digesters and gas storage systems were gradually replaced by prototypes characterized by the separation of the gas storage from the digester.



biogas technologies introduced in Burkina Faso

- Based on the results of earlier research work, IRSAT carried out a research program with support of the German Appropriate Technology Exchange Centre (GATE, part of GTZ) from 1982 on with the following objectives:
  - Reduction of digester cost
  - Development of burners for cooking and absorption refrigerator
  - Biogas adaptation of engines originally run by gasoline, gas oil, and oil
  - Technological and biological improvements of the outputs of biogas digesters
  - Setting up a strategy for pre-vulgarisation of the biogas technology
  - Analysing urban biogas application for pork breeders in Ouagadougou

biogas technologies introduced in Burkina Faso

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

    Through these improvements, the digester cost was reduced from \$120 to \$60 /m^3.

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

biogas technologies introduced in Burkina Faso

- All the technologies presented above were discontinuous or semi-discontinuous batch digesteurs.
- In 1982 : 2 continuous 10 m^3 biogas plants with fixed dome were installed by IRSAT in "petit séminaire de Pabre" and maintained until 1995 ; they had served for cooking.
- In 2006-2007 another 2 continuous fixed dome BORDA 20 m^3 digesteur for cooking have been installed by IRSAT in the Rural school of AMPO in the Ouagadougou Suburban

Lessons learned

The problems encountered with these units were:

- ***Technical:***
  - Leakage of gas on the level of the water seal
  - Cracking of the digester
  - Short life time of installations
- ***Organisational:***
  - Selection of the sites: site with no structure capable to manage the installation due to the social character of the establishment (hospital); unavailability of organic matter on the sites - Medical centres, military camp. Operators had to transport organic matter over long distances.
  - No permanent water supply: lack of water during dry season; to feed the biogas installation, the users had sometimes to go far for fetching water.

Lessons learned

-*Organisational (suite):*

- **Lack of ownership** : the installations were entirely financed by donors or by the state. Biogas was economically not competitive as fire wood was not yet bought but still collected for free.
- **Missing follow-up to the users**: who did not carry out regular and correct maintenance of the installations due to lack of training and ownership.
- **Lack of human resources, material and financial** means led to a situation where IRSAT was not able to make the required follow-up of the installations.

-*Social*

- **Hard work** required for loading and emptying which was also considered as dirty work
- **Biogas flame** was perceived as **small** and cooking with biogas very **slow**.
- **No integration** of agriculture and livestock activities
- **Inadequate dimensioning of installations**: the majority of the biogas units were dimensioned without taking into account the energy needs of the users.

Lessons learned

- **30 years of experiences** with multiple technologies - floating drum, fixed dome, batch, semi-discontinuous, continuous model were adopted and tested, but:

  - biogas requires a lot of hard work and follow-up
  - the construction material have hight costs
  - technical construction must be of quality to avoid cracks and leakages
  - local capacities has to be built for maintenance
  - 100% subsidies is no ownership
  - Wastewater has to be taken taken into consideration
  - Women use biogas, but maintenance depends on strong men
  - Biogas stove must be of good quality and efficiency

Lessons learned

- Despite theses difficulties, many biogas installations (~42 out of 60) have been operated for several years (up to 12 years), because of:
  - Lack of alternative for rural energy
  - Modernity (gas stoves, electricity production)
  - Use of pre-composted straw stalks for biogas production
  - Simple and didactic process design
- No real household experience gained; mainly biogas for schools, hospitals, military compounds

Route to B4BL

- **Feasability studies**
  - Potentials of 100 000 plants from now to 2030
  - Only in Households
  - Cost of 6 m3 = US $1000
- **Institutionnal assesment**
  - Livestock ressource ministry : leader
  - Comité de pilotage
  - Main potential participants to the program have been identified
- **Market study** : the potential for the market 31 000 biogas unit in the pilot région of Sud-ouest, Cascades and Hauts Bassins
- **Formulation of the NBP with a national team**
  - Livestock ministry
  - IRSAT
  - Ministry of agriculture
  - Ministry of environment
  - RCPB, Artisans associations
- **Support GTZ, SNV**