

Teriya Bugu in Mali

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Africa has abundant potential of bioenergy in the form of plant and animal residues. This form of energy, when integrated with other renewable forms, not only improves access to energy but also brings rural areas broad-based and inclusive development. This idea has been embraced since the beginning of Teriya Bugu.

Renewable energy in Mali

The energy sector in Mali is characterised by a high dependence on oil. Electrification rates are still very low, especially in rural areas (18% of rural towns and villages as compared to 70% in urban centres). Seventy-eight percent of household energy needs are satisfied by biomass resources (mainly wood and charcoal), which causes health problems from indoor air pollution, such as respiratory infections and eyes diseases. The use of biomass for energy also aggravates environmental degradation such as deforestation and land degradation.

The projected expansion of the national electricity grid is unlikely to connect a significant number of isolated low-income populations in the next decades. There is however both a need and a market for off-grid electrification schemes. Renewable energy (RE) has great potential to address many sectoral challenges as well as to contribute to socio-economic development and poverty reduction. Mali stimulates this RE off-grid potential by targeting all available sources, like solar, hydro, wind and biomass. Various uses of biomass have been introduced and tested in Mali, such as domestic or community-managed biogas projects and bio-ethanol production using sugarcane or biodiesel (Jatropha), but these have only reached a small percentage of the population.

Mali has however restructured and strengthened a number of its institutions in the effort to develop the RE (sub-)sector; this includes the National Agency for the Development of Biofuels (ANADEB). The vision and targets of Mali have been formulated in a number of policy papers, including the National Strategy for the Development of Renewable Energies (2006) and the National Strategy for the Development of Biofuels (2008); both of these were recently updated within the framework of the ECOWAS Renewable Energy Policy (ECREEE). The Government of Mali has also set up the Renewable Energies Agency of Mali (AER-Mali), a public science and technology institution that will provide a structure for monitoring and research as well as capacity development. It manages the Renewable Energy Project that has the objective to set up an innovative financing mechanism with local banks using public-private partnerships (PPPs). Loans will be provided that are adapted

to the renewable energy sub-sector. This is being done in order to promote the development of clean energy, contribute to the reduction of the energy deficit in Mali and to protect the environment. There is a focus on solar energy kits, but similarly this programme can also boost biogas as part of the energy mix.

ANADEB's key ambitions

- *Development of a national programme on biogas*
- *Research and management of various waste materials for biogas*
- *Distribution of 7,000 biogas digesters (2017-2021)*
- *Operationalisation of a bio-energy quality control laboratory.*

There are a number of challenges in the implementation of the regulatory framework:

- *Institutional challenges:* coordination among the mentioned agencies, weak planning and inadequate support to PPPs;
- *economic and financial challenges:* high investment costs versus weak local financial institutions and inadequate financial incentives to attract the private sector;
- *technical challenges:* limited capacity in the sector and lack of access to information
- *social challenges:* lack of awareness raising among consumers on RE opportunities and challenges, and poverty in general of Malian households.

All of these impede affordability, access and use of RE without subsidy schemes.

Use of renewable energy

Teriya Bugu, meaning "the village of friendship" in Bambara, is a community development centre, located 2 hours from Ségou in the direction of San. Its history begins in the seventies, when French citizens Bernard Verspieren and Malian Lamine Samaké developed a model farm and experimental centre on agriculture and renewable energy along the river Bani. Along with the centre, the idea was also to develop a solidarity tourism facility. The objective was to create an example of sustainable development while at the same time supporting the rural community of Korodougou. The centre integrates agriculture, bioenergy development and tourism. It currently occupies 220 ha including the village, and is managed by the *Association d'Entraide pour le Développement Rural* (AEDR).

Teriya Bugu grows various fruit and a wide variety of vegetables and keeps rabbits, chickens and ducks, which are also used in the restaurant. In addition, it keeps horses and donkeys for tourist rides and to work on the land. More than 200 hives produce honey, a product which is highly



Photo by Gazomètre Teriya

appreciated. Production keeps up with the needs of the restaurant with local re-sellers taking care of the rest. Teriya Bugu would consume around 65,000 litres of diesel fuel per year to provide electricity to the centre. In order to reduce this dependency and as part of its renewable energy policy, Teriya Bugu decided in 2006 to start the renewable energy project, producing fuel from the *Jatropha curcas* plant. Also, in collaboration with CIRAD, a research programme was started on *Jatropha*.

AEDR uses and promotes a mix of renewable energy: biogas, solar panels, solar heating, and a local biofuel industry with the cultivation of *Jatropha* shrub oilseeds. The electricity, produced by two (25 kW and 33kW) bi-fuel motors, supplies the independent local grid of the centre (including the hotel, school, clinic, welding shop, etc.) and the village where the employees live (500 people). The *Jatropha* cake is used in a Transpaille® biogas reactor with a capacity of 50 m³ producing 12,000 m³/year of biogas; this supplies the centre kitchen. Biogas thus obtained is stored in two flexible containers that each hold 50m³ of biogas. These are pressurised with sandbags and supply several gas stoves at Teriya Bugu. Solar energy is used for water heaters and for irrigation water from the Bani River, saving over 7,500 litres of diesel per year. Teriya Bugu further promotes a garbage collection system in the village. The waste treatment plant adds to the production of biogas. Composting at the plant also produces digestate (7 tons/year), which aids in development. Tests are carried out on these organic fertilisers.

The activities of Teriya Bugu support in total 7,000 people in the community of Korodougou. The bio-energy mix (electricity and biogas) is enough for its needs, thus saving more than 35,000 litres of diesel per year, *i.e.* around 1,400 Euros/month.

WABEF and Teriya Bugu

AEDR-Teriy Bugu is a promotional centre for RE and especially for bioenergy. As such it is an ideal partner to promote anaerobic digestion of bio-wastes in Mali. For demonstration purposes, the Transpaille® unit was rehabilitated to allow the anaerobic digestion of *Jatropha* cakes. In order to make the centre fully operational for demonstration purposes, instruments to better monitor the biogas plant were put in place at an on-site laboratory. This allowed for the assessment of the pH, dry matter and volatile solid composition of organic residues and their biogas potential. In parallel, an educational exhibition was developed to inform the visitor. Panels explain the equipment seen, its operation and its integration in the site, and this is very much appreciated by the visitors and trainees.

Closing the loop of the biogas value chain has been done by using the biogas directly for cooking and the digested *jatropha* cakes as a fertiliser for the crops. *Jatropha* by-products (fruit shells and cakes from pressing) are poorly valued in general. The raw and processed *Jatropha* cakes were analysed and their potential agronomic value assessed in terms of:

- (i) fertiliser: available nutrients

(ii) soil conditioner impact on physical and biological properties of the soils

(iii) safety: presence of toxins and heavy metals.

The raw *Jatropha* cake and the digested *Jatropha* cake have high nitrogen mineralisation potential, and despite a high presence of phorbol esters toxins may be considered as organic fertilisers. Experiments at Teriya Bugu showed no presence of these toxins in fruits and cereals after fertilisation with *Jatropha* cake, while the yield of tomatoes improved considerably (from 22 t/ha to 31 t/ha, Traoré, Kamaté et al, 2015). In Mali, there is no standard yet for the use of *Jatropha* fertiliser, but AEDR is working on this with ANADEB.

In addition, WABEF analysed the business of the centre. This exercise provided insight into the social business of biogas, highlighting the need to look at various segments and to combine mixes of inputs and outputs. Since the rehabilitation of the bio-digesters, Teriya Bugu no longer lacks biogas to meet its cooking needs for the hotel. This results in savings on hotel costs and also an increase in the purchase price of seeds of *Jatropha* to producers (100 FCFA / kg instead of 75 FCFA of *Jatropha* seed). Teriya Bugu is now able to generate sufficient biogas and fertiliser for its needs.

The 55 cooperatives that Teriya Bugu works with are involved and informed about the process of valorisation of *Jatropha* cake and also of the waste. Teriya Bugu is planning now to further increase its production of RE, serving the village in biogas for cooking purposes and producing electricity for the community.

Teriya Bugu is one of the pioneers of renewable energy in Mali, with more than 30 years of experience. Together with other experiences, like that of SNV and AVSF, who are running programmes on developing family biogas in Mali, the community approach serves as a model for rural community development. Mini grids using mixes of renewable energy in villages that have sufficient raw material available are an inspiration.

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Centre Songhai: Integrated development of renewable energy in Benin

Centre Songhai in Porto-Novo in Benin is an innovative organisation for integrated development that puts human capital and bio-energy development at the centre of its activities. Currently, the Songhai model has been replicated in Benin and Nigeria and in 15 other African countries, with the support of various donors including UNDP, Songhai was recognised as a Regional Centre of Excellence for Africa by the United Nations in 2008.

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Songhai was created in October 1985, borrowing its name from a powerful and flourishing West African empire of the fifteenth century. The idea of the creation of Songhai Centre came from Father Godfrey Nzamujo, who together with others who shared his vision of giving Africa back its dignity. Supported by the government, the project at Ouando (a neighbourhood of Porto-Novo) was started on an acre of land specifically targeting African youth. Songhai Regional Centre in Ouando now covers more than 22 hectares of land and is mainly used as the organisation's headquarters and as an experimental site.

Songhai is a unique integrated development programme, designed to radically address unemployment and food insecurity associated with poverty. It also addresses environmental management. It is not simply a typical model