

## **PRESERVATION OF WOODY FOREST RESOURCES THROUGH ENERGY ALTERNATION IN MALI: METHODS AND ADVANTAGES**

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**Abstract.** This study aims to prove the need for the promotion and extension of new and renewable energies in both rural and urban areas for the preservation, protection and conservation of forest resources in the Republic of Mali, including the dependence of populations on resources are very important leading to deforestation and soil degradation knowing that many strategies and approaches aimed at the sustainable management of forests have experienced obvious failures. The methodology was based on the observation of the vegetable map of Mali, the cartographic analysis and the consumption of wood, the documentary collection and the realization of qualitative surveys. The study revealed the low frequency of energy coverage by new energies although there are wills and actions, the urgency is there to diversify the sustainable tools of consumption by clean energies. Taking into account this energy alternation will undeniably make it possible to preserve the Malian forests by reducing the dependence on forest resources by urban and rural populations.

**Keywords:** *Forest management, alternative energy, classified forest of Mali, biomass consumption.*

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### **1. Introduction**

If the problems of pollution, nuisances, the combustion of fossil resources which affects biodiversity and worries the experts who are the first to report on the disasters which generate, one of the cruellest major problems would be especially deforestation, the irrational exploitation of our wildlife and plant resources (United Nations Framework Convention on Climate Change, 2015).

The FAO presents almost every year the state of the world's forests. In 2015, world leaders endorsed the United Nations 2030 Agenda for Sustainable Development (SDGs) and its 17 goals, which would become the central guiding framework for development policies around the world (FAO, 2015). The 2017 edition aims to help us understand how forests and their sustainable management contribute to the achievement of several of these SDGs.

In most countries, on all continents, this drama exists at worrying proportions. This is the case with industrial and mining exploitation, excessive logging, climate change, devastating natural fires, bush fires, developments, the expansion of agriculture, concessions crowned with incivility (Birnbaum, 2012; Kouame, 2014).

The 2018 edition of FAO's State of the World's Forests considers actions that could be taken to improve the contribution of forests and trees and without which it is difficult to accelerate progress towards the SDGs (FAO, 2018). It has become essential to act to establish a collaboration with the economic, social and environmental benefits it provides.

The 2020 edition came out at a time when the world is facing a deadly COVID pandemic. It traces the state of the world's forests, in particular: deforestation, bush fires, issues related to food security, community livelihoods, the fight against poverty, forest-biodiversity and human health, factors of change that affect biodiversity and forest resources, the fight against deforestation and forest degradation, food products from forests and the implementation of the global plan of action for forest genetic resources (IPCC report on climate change and its future developments., 2014). Notwithstanding the awareness and multidisciplinary research work and studies by experts, this drama is growing and affecting all continents.

In Africa, extreme economic poverty, conflicts, energy poverty in terms of new and renewable resources and extreme dependence on forest resources by populations who live mainly in rural areas, exploitation and development in forests mortgage any possibility of regenerating these endangered resources (Gautier, Compaore, 2006; West Africa Thematic Report Land Degradation Neutrality: Benefits for Human Security (UNCCD), 2019).

Mali is a continental country in West Africa that is part of the zone called the Sahel. Currently 90% of the population live on 30% of the national territory. The southern part of the country is considered to be home to most of the forest formations estimated at 37,741,231 ha or 8% of the country's area (DNEF, 2014). Malian forest resources are subject to several pressures, including among others: agricultural clearing, increased consumption of wood and charcoal, removal of timber and service wood, bush fires (early and late) which ravage more than 100,000 ha per year and harvesting for traditional medicine (Mbodj, 2014; National Forest Policy, 2017).

In a country exposed to climate change and where the degradation of land and natural resources is a real problem, the resource of firewood cannot provide an adequate response to growing energy needs (Ministry of Energy and Water, 2020).

Despite the initiatives and actions carried out within the framework of the preservation of Malian forests by politics, the situation remains worrying. This probably indicates that all the parameters have not been taken into account for rational forest management. Knowing well that the dependence of wood-energy by rural and urban communities is a wound against forest ecosystems, other mechanisms must be favored by decision-makers to remedy the evil of knowing energy alternation at first on board. Taking this dimension into account will make it possible to meet the needs for wood and facilitate the implementation of income-generating activities by the communities.

We will advance the types of energies necessary, the assets and the advantages of these energies for the development of communities, a guarantee of the sustainable management of Malian forests.

## **2. Methods and materials**

The methodological approach was based on:

*Observation:* The observation of the plant map of Mali, the maps produced by Landsat 8 and the frequency of wood used by populations in rural and especially urban areas whose dependence on wood energy is very strong.

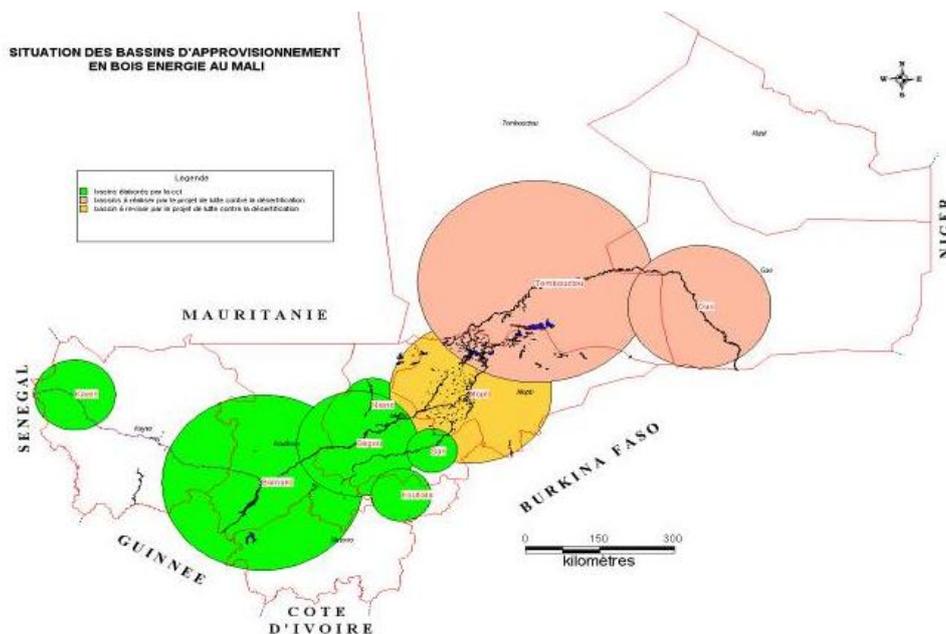
*Preparatory stage in the office:* At this stage, the information has been collected via the documents to know more about the actions carried out or in progress in order to contribute through our analysis to the preservation of Malian forests on the verge of climate change through sustainable measures such as the promotion and extension of

new energies as an alternative to deforestation and its attendant degradation of ligneous resources.

*Qualitative surveys:* This led us to get closer to the various structures in charge of forests such as: The National Directorate of Water and Forests, the Ministry of the Environment, Sanitation and Sustainable Development, the Ministry of Energy and also the structures which work for the promotion of rural electrification and that of new and renewable energies such as: AMADER. Interviews with these resource people allowed us to clearly identify the need to respond to the socio-economic and environmental concerns of the populations and the preservation of forest resources through energy alternation.

### 3. Results and discussions

The wood energy potential is estimated at 33 million hectares with a standing volume of approximately 520 million m<sup>3</sup> and a weighted productivity for the whole country of about 0.86 m<sup>3</sup>/ha/year (Ministry of Energy and Water, 2020). The implementation by AMADER of Supply Master Plans (SDA) on all the extent of the territory has made it possible to establish the following map of the wood-energy deposit (Ministry of Energy and Water, 2020).



**Fig. 1.** Location of energy wood supply basins (Final report of the SREP-Mali inventory, 2011)

As you can see here the concentration of wood resources in the southern regions of Mali including: Sikasso, Koulikoro, Segou, Kayes and Bamako district. In addition, let us remember that the human concentration is at these levels with more than 70% of the population, there have never been any wood shortages in these areas, this sufficiently shows the current ecological calamity whose attention must be paid by modern cooking methods, rural electrification, the creation of income-generating activities (International Plan, 2016). In the central and northern regions, crop residues

and animal waste are the energy base, especially for cooking, while it is the sunniest place that must be used to produce new energies adapted to the climate.

The impact of fuelwood consumption on forest formations is enormous and as proof, the supply of the Bamako District alone, which concentrates 12.46% of the total population in fuelwood for the year 2016 required 1,095,070.33 steres, i.e. a clearcut of 21,901.40 ha <sup>6</sup> of a plant formation of the wooded savannah type (AIE, 2021). For the year 2017, from January to November, 1,103,121.66 cubic meters of wood were needed, i.e. 22,062.43 ha of the same type of plant formation (DNEF, 2017). On average, it was necessary to deforest the equivalent of about 22,000 ha to meet the fuelwood needs of the District of Bamako during the period 2016-2017.

In a country exposed to climate change and where the degradation of land and natural resources is a real problem, the fuelwood resource cannot provide an adequate response to growing energy needs.

The implementation of the various projects and programs resulted in the main indicators of the energy sector below:

**Table 1.** Energy sector indicators 2012 – 2016 in Mali (AIE, 2021)

Variables	2012	2013	2014	2015	2016
Electricity access rate	31,7 %	32,4 %	34,9 %	35,7 %	38,2 %
Access rate to electricity in urban areas	64,1 %	66,8 %	70,7 %	79,5 %	88,6 %
Rate of access to electricity in rural areas	17,8 %	17,2 %	17,4 %	16,7 %	19,9 %
Average low voltage electricity tariff, EDM SA scope (urban centers), excluding VAT (in CFA )	100	105,2	105,6	105,4	104,2
Average price of electricity in the areas of AMADER operators (in CFA francs)	245 ≤ et ≤ 300				
EDM electricity production (GWh)	1 276	1 420	1 574	1 594	1 768
Rate of renewable energies excluding hydroelectricity in electricity production			7%	7%	NA*
Consumption of petroleum products per year (TOE)	911 839	972 928	1 024 000	1 056 864	1 373 533
Butane gas consumption (in tons)	13 279	12 010	12 228	12 982	14 530
Biomass consumption	78% du National energy balance 2014			71,6 %	73,2 %
Import of all Hydrocarbon consumption	17% balance sheet 2014			24,9 %	22,3 %
electricity consumption	5% balance sheet 2014			3,5 %	4,6 %

\*: NA Not available

The electricity sub-sector contributes 1.91% of the GDP. Mali imports all of its fossil fuel needs. The petroleum sub-sector accounts for 26% of all 2010 imports and

22% in 2015, which makes it very sensitive to price volatility. This is the reason we must focus on new and renewable energies in accordance with the challenges.

At level economic, the forests remain the main source of domestic energy through wood and charcoal used by almost all households in Mali, most without access to alternative energy (gas and electricity). The consumption of wood and charcoal is estimated at 459 kg per person per year (Biodiversity Research Foundation, 2017). This makes the exploitation of timber forest products the most important forest economic activity in terms of volume and income. It has generated approximately 1 146 584 211 F.CFA of average income per year from 2014 to 2017 (DNEF, 2017). In reality, these are only quantities under the control of the forestry services, and therefore lower than the actual quantities, it being understood that the said services lack the human and material resources to produce exhaustive statistics in this area.

The National Report on the State on the Environment, 2017 edition of the Ministry of the Environment, Sanitation and Sustainable Development has identified solutions towards an energy transition to preserve forest resources. The concept of energy transition is defined as the transition from conventional energies to new and renewable energies that are less polluting, efficient, economical and controllable from an energy point of view (International Renewable Energy Agency, 2019).

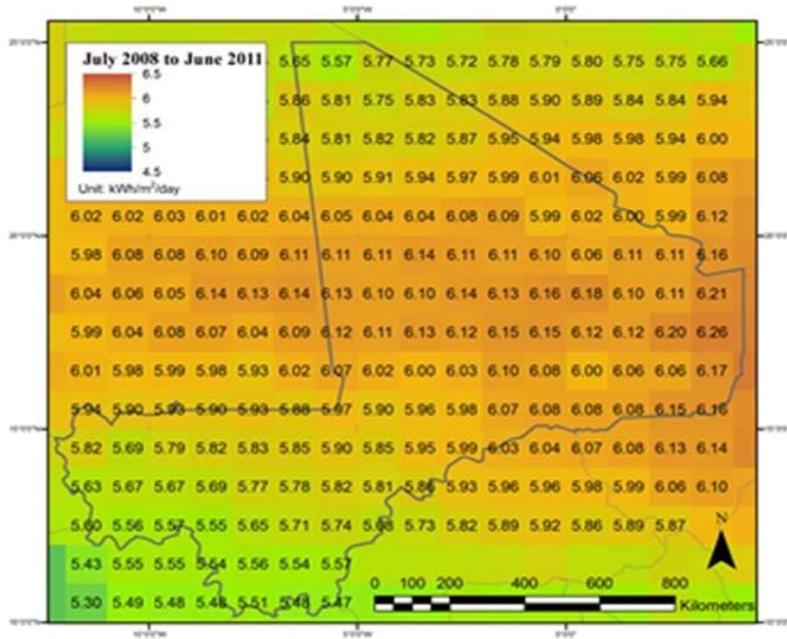
The energy transition will be of great contribution to the safeguarding of forest resources in Mali. According to the TCN-AEDD-MEADD study, entitled "Energy transition in the residential sector as a mitigation measure for greenhouse gas emissions in households" carried out in December 2016, the application of actions within the framework of the transition energy, in particular the energy mix for cooking and heating, would among other things reduce by 40% the annual consumption of wood energy, or 49 7315 kg (African Development Bank Group, 2015). Developing renewable energies and increasing access of rural and urban populations to electricity at a lower cost is becoming a leitmotif in Mali. Several important actions are being implemented to strengthen production capacities, network extension, and promotion of electrification in rural areas and development of renewable energy sources (Palliere, 2014). Private investors in the fields of renewable energies have benefited from the tax exemption for solar equipment for several years. Some banks instead promote access solar power project developers to equipment through the terms of favorable payment, plus the banker Guarantee Fund which proves a real facilitation instrument of investment by sector private.

Solar irradiation is very high and distributed throughout the national territory. It reaches an average of 6 kWh/m<sup>2</sup>/d for a daily sunshine duration of 7 to 10 hours. Solar technology particularly suitable for feeding people's electricity remote areas and isolated. Despite this potential, solar technology struggles to prevail and almost all installed capacity comes from solar installations independent.

Unfortunately, in spite of this potential of solar energy, the countries of the Sahel in general and Mali in particular do not take advantage of this mass of energy.

In terms of wind energy, although wind potential is located in very specific areas, Mali has already installed 150 grain mills and water pumping systems, as well as a dozen small turbines that generate electricity. electricity from wind energy. It is a very rare source of energy in Mali yet very important given the geographical location of Mali in general. It will allow communities to carry out income-generating activities, counter-seasonal cultivation and even local livestock farming, thus avoiding distant nomadism with animals and market gardening. It should be noted that Mali is an agricultural

country par excellence. By doing so, the forests will undeniably be preserved by reducing the dependence of the populations (Trommette, 2017; Tessogue, Coulibaly, 2021).



**Fig. 2.** Map of solar radiation in Mali Source (National Renewable Energies Action Plan (PANER) of Mali, 2015)



**Fig. 3.** Solar energy for rural electrification (Rural Electrification in Mali, Technologies and Financing, 2012)



**Fig. 4.** Wind energy for vegetable growing  
(Rural Electrification in Mali, Technologies and Financing, 2012)

Access to modern energy initiated as part of Mali's SEforALL 2030 objective and targets program, access to modern energy includes access to electricity and the use of improved cooking stoves. The government proposes to develop widespread and accessible modern cooking, through the sustained strengthening of clean, safe, sustainable and affordable technologies, as well as through the promotion of technologies using alternative fuels to wood energy, in particular LPG, popularization thrust of multifunctional platforms for rural electrification and support for access to electricity (Mali Sustainable Energy for All Investment Prospectus. SEforALL in Africa, 2020).

**Table 2.** SEforALL Energy Access Goals for Mali (Mali Sustainable Energy for All Investment Prospectus. SEforALL in Africa, 2020)

	Goals 2020	Goals 2030
Electrification	National electrification rate of 63.4% (urban: 90%, rural: 52%)	National electrification rate of 87% (urban: 100%, rural: 81.5%) 10,000 PTF multifunctional Platform
Cooking	34.3% of the population have access to gas Butane 44% of the population have access to clean cooking equipment	62.5% of the population have access to Butane gas 82% of the population have access to clean cooking equipment.

**Table 3.** SEforALL Renewable Energy Goals for Mali  
(Mali Sustainable Energy for All Investment Prospectus. SEforALL in Africa, 2020)

	Goals 2020	Goals 2030
NRE capacity connected to the network	618,4 MW (47%)	977,4 MW (52,5%)
Solar electric capacity	268 MW	538 MW
Hydro electric capacity	335,4 MW	389,4 MW
Wind capacity		20 MW
Bioelectricity capacity	15 MW	30 MW



**Fig.4.** Different types of modern cooking  
(National Renewable Energies Action Plan (PANER) of Mali, 2015)

As part of the implementation of these national policies and strategies in place, the Malian energy sector is evolving as a whole from 2015 for the 2030 horizon towards diversification and sustained exploitation of national energy resources, in particular of renewable sources (including hydroelectricity, solar energy and bioenergy) to meet the growing demand for energy. Indeed, the primary energy balance will remain dependent on biomass (in particular wood energy).

However, the rapid development of many projects/programs and various initiatives in the fields of small hydroelectricity, solar energy and bioenergy will make it possible to induce a significant reduction in the primary consumption of wood energy (IUCN, French Committee, 2015).

These are pictures of different types of stoves to reduce wood burning for cooking. The fact remains that they are less effective in preserving forest resources. Our

goal is to see forests regenerate, preserve and protect through the popularization of new and renewable energies, rural electrification. These stoves will be a plus in achieving our goal.

#### 4. Conclusions

The energy sector, still dominated by biomass, is in transition. Firewood, the main source of energy for households, comes from the country's forests, the capacity of which is estimated at 37,741,231 ha or 8% of the country's surface area. In a country exposed to climate change and where the degradation of land and natural resources is a real problem, firewood resources cannot provide an adequate response to growing energy needs.

The consumption of wood energy dominates the total final energy consumption and particularly in the residential sector, which leads to worrying deforestation and justifies the use of improved stoves and modern means of cooking.

The Government's policies on energy and actions in favor of investments will be very weak in terms of the promotion and popularization of new and renewable energies, the only guarantee of responding to the present concerns of the fight against change in preserving Mali's forest resources. The creation of socio-professional schools and training, non-taxation on the import of equipment for new technologies of new energies, rural electrification, the promotion of modern ecological cooking methods, the creation of income-generating activities for rural populations in addition to agroforestry and participatory management are among other means and tools to preserve Malian forests.

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