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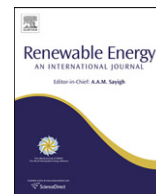
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The energy-enterprise-gender nexus: Lessons from the Multifunctional Platform (MFP) in Mali

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ABSTRACT

The Mali Multifunctional Platform (MFP)—a government managed, multilaterally sponsored energy program that distributed a small diesel engine attached to a variety of end-use equipment—expanded access to modern energy services and raised village incomes from 1999 to 2004. Over this period, it successfully distributed more than 500 MFPs throughout Mali, and in doing so empowered women, improved educational opportunities, and enhanced food security and community cohesion. The MFP has also motivated the government to install 1800 such platforms by the end of 2012. Based on original research interviews supplemented with an extensive literature review, this study introduces readers to the rural energy situation in Mali and describes the history of the MFP project. It then discusses the benefits the project achieved, as well as five sets of challenges the MFP faces: a growing number of non-functional platforms, lack of policy coordination, poverty, dependence on imported technology and fuel, and patriarchy. The study concludes by offering six lessons for energy development planners and practitioners.

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1. Introduction

The Republic of Mali is home to Timbuktu, a bastion of trade and development under the Mali Empire of the twelfth, thirteenth, and fourteenth centuries. It was then described as a “gift of the Niger” and boasted some of the first brick buildings ever constructed. Despite its illustrious past, today Mali remains one of the poorest countries in the world. It is one of the nine least-developed economies across the globe and has a per capita Gross Domestic Product (GDP) that is *one-tenth* the worldwide average [1]. Indeed, broader West Africa and the Sahel desert is so impoverished that almost half (44 percent) of its population—an estimated 77 million people—live below the monetary international poverty line of \$1 per day, the highest percentage of any territory in the world [2]. Correspondingly, Sub-Saharan Africa—which contains more than fifty countries and a population of 800 million—has less installed electric capacity than Spain, home to only 46 million people. Eighty percent of the sub-Saharan population relies on solid fuels for cooking on open fires,

leading to 4.2 child deaths per every thousand inhabitants and other health problems [3].

In 1993, however, the United Nations Development Program (UNDP) and the Mali Government started a pilot project for a novel energy program called the Mali Multifunctional Platform (MFP), or *Projet Plate-forme multifonctionnelle pour la lutte contre la pauvreté au Mali*. This project was designed to simultaneously distribute energy services, empower women, and support local enterprises. Between 1999 and 2004, the government deployed the MFP project at a national level, distributing over 500 platforms for the benefit of more than half a million individuals. At the close of this effort in 2004, MFPs served about 5 percent of the rural Mali population. The MFP has increased the productivity of women, alleviated and displaced time-intensive and labor-intensive activities related to cooking and collecting water, and provided new business opportunities to villages. The MFP was so effective that it gained the personal support of Mali's President, who adopted the slogan “One Platform for every village.” Since 2005, the MFP has become a self-sustaining national project and Mali is expected to install an additional 1300 platforms by early 2013 [4]. Based on the success of the MFP in Mali, other countries including Burkina Faso, Ghana, Guinea, and Senegal—have initiated their own MFP programs. Drawing from original research with institutions in Mali and six other countries, this article explores the history, benefits, challenges, and lessons derived from the Mali MFP program.

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2. Research methods

To collect data on the Mali MFP project, the research team relied on interviews of stakeholders and an extensive literature review. The authors conducted 15 semi-structured interviews at 11 institutions in eight countries in March and April 2012, selected to represent a sample of the stakeholders involved in the MFP project. Participants occupied middle and senior management positions at institutions including:

- Government ministries such as the Malian Agency for the Development of Domestic Energy and Rural Electrification;
- Multilateral institutions such as the United Nations Development Program;
- Bilateral institutions such as the United States Agency for International Development;
- Nongovernmental organizations such as Mali-Folkecenter;
- Intergovernmental organizations such as the Economic Community of West African States

Research interviews lasted between thirty and 90 min. Semi-structured interviews were chosen because they were formal enough to ask the same set of questions, but flexible enough so additional questions could be worked into a conversational flow as needed. Specific questions asked included: “What are the most serious energy policy and security challenges facing Mali?,” “What were the drivers behind the creation of the MFP program?,” “What were its most important benefits?,” “What were its most significant challenges?,” and “What lessons does it offer energy policy more generally?” We encouraged participants to give their own explanations and allowed the flow of the conversation to provide the wealth of information required to derive our conclusions found below.

Our interviews were especially difficult to complete given that during the time we did them, Tuareg militants fighting on behalf of the National Movement for the Liberation of Azawad seized control of Timbuktu and attempted to secede from the nation, inducing a civil war that culminated with a failed military coup and a declaration of independence on behalf of the rebels in early April 2012.

The data from these interviews is presented here as anonymous for multiple reasons. First, confidentiality was mutually agreed upon at the beginning of each interview to adhere to institutional review board guidelines. Second, anonymity protects respondents from retaliation over divulging potentially controversial information. Third, it can encourage candor, as people often speak their minds if they no longer have to worry about their statements coming back to haunt them. Fourth, individuals were not speaking on behalf of their institutions, but were instead giving their personal opinion, making institutional affiliation less relevant (though still important for sampling purposes). One drawback to anonymity is that there is no guarantee this study can be replicated, because the authors cannot divulge the identity of respondents without their permission.

We supplemented these interviews with an extensive review of the academic literature on Mali and project documents related to the MFP in both English and French.

3. Country background

Mali, a vast continental country in the heart of West Africa, is bordered by Algeria, Burkina Faso, Guinea, Côte d'Ivoire, Mauritania, Niger, and Senegal. It has a population of about 15 million, and its government is divided into three districts, nine administrative regions (Kayes, Koulikoro, Sikasso, Segou, Mopti,

Timbuktu, Gao, Kidal, and the District of Bamako), and 703 municipalities—in which only 19 of these are classified as urban [5]. As Table 1 summarizes, its social and economic development has lagged behind other emerging economies [6] [7]. Mali's national GDP is ranked 125th at \$9 billion, it has a per capita income of only \$470, and the government must manage its affairs with only a \$1.7 billion annual budget.

In the energy sector, Mali significantly lacks domestic oil supplies and consumes very few petroleum products—less than 300,000 tons of oil equivalent per year. Biomass, inclusive of fuelwood and charcoal, meets 90 percent of the national energy demand. Mali consumes nearly 6 million tons of fuelwood per year, which results in a deforestation rate of 400,000 ha per year. Most Malian households use an average of 2.5–3 tons of biomass per year to cook food. Alternatively, as one respondent put it, “most of the households in rural areas satisfy their electricity needs by using kerosene and batteries.”

Access to electricity is severely lacking in Mali. The national electricity rate is 24 percent, but this rate drops to less than 13 percent for rural populations. Electricity, overall, accounts for less than 1 percent of the national energy balance. Put another way, average energy use amounts to about 57 kWh per year—compared to the West African average of 88 kWh per year, a world average of 2373 kWh per year, and an OECD average of 8000 kWh per year. Electricity demand continues to grow at 10 percent per year, primarily in Bamako, though it is a very costly commodity. Relative to its neighbors, the cost of energy in Mali is very high. Electricity is around 20 cents per kWh in urban areas and 40 cents per kWh in rural areas—adjusted for purchasing power parity. Mali's growing energy demand has been met with diesel generators, and oil and electricity imports from neighboring countries such as Côte d'Ivoire. The country imports all of its oil from the Société Ivoirienne de Raffinage refinery at Abidjan, Cote d'Ivoire and the Societe Africaine de Raffinage refinery at Dakar, Senegal, and 47 percent of its electricity is from these and similar sources. It is unlike Côte d'Ivoire—which can generate electricity through its own gas fields—or Senegal—which benefits from the hydropower that Mali generates on the Niger and Senegal River [15,8–13]. As one respondent bluntly put it, “Mali is energy deprived.”

To overcome energy challenges, Mali's government declared a four-pronged energy policy to: enable access to modern energy at affordable prices, protect and preserve existing fuelwood resources, realize the full potential of domestic energy resources, and establish efficient strategies for energy use by sector [14,15]. A poverty reduction strategy adopted by the government in 2002 slightly augmented these objectives to include expanding access to electricity, reducing fuelwood consumption, and promoting solar energy [16]. The government set an ambitious national target of electricity access for 55 percent of the population by 2015, and

Table 1
Selected social and economic development indicators for Mali.

Indicator	Mali	Average for developing regions
Proportion of population living on less than \$1 per day	73%	23.2%
Prevalence of underweight children less than 5 years of age	43%	28%
Net enrollment ratio in primary school	43%	82.1%
Literacy rate of 15–24 year olds	37.1%	84.4%
Mortality rate per 1000 live births	231	90
Maternal mortality ratio per 100,000 live births	630	440
Average life expectancy	54 years	67 years

created the Agency for Household Energy and Rural Electrification (AMADER) in 2003 to manage rural electrification projects through 15 year concessions with private energy companies [13].

Yet a number of factors have constrained the government's attempts to provide energy services. As of 2010, AMADER signed concessions with 80 private sector operators, but these operators reached only 180 villages out of thousands. The rising cost of petroleum in 2008 and 2009 coincided with a fall in market prices for two of Mali's main exports, cotton and gold, which lead to a growing national deficit. The import and export route to Abidjan was closed in 2002, and dependence on imported petroleum products amounted to about 10 percent of the national energy balance in 2010. Most recently, the electrification rate in Mali dropped from 2009 to 2010 due to a rapid and unexpected growth in population (3.6 percent according to the last census) in areas unserved by the grid [17]. As an independent evaluation by the United States Agency for International Development (USAID) concluded, "the challenge for Mali is to meet its energy demand growth with affordable, reliable, domestic and imported energy supplies." [13]

4. History of the MFP

Remarkably, however, one national energy project has been successful at expanding energy access to rural areas in Mali despite these constraints: the MFP. Planners explicitly designed the MFP to meet the energy needs of more than 7000 rural villages in Mali, each of which are home to about 1000 people [18]. Efforts to adapt conventional grain-milling machines to meet rural development challenges dates back to the 1980s when Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) implemented a project to use vegetable oil derived from jatropha seeds as an alternative to diesel fuel. That project, however, was terminated when it became clear that the jatropha oil was more expensive than the diesel fuel it was trying to displace [19].

The MFP program itself started in the early 1990s. With support from the UNDP, United Nations Industrial Development Organization, and International Fund for Agricultural Development, the Malian government started a 1993 MFP pilot project designed to install 4 platforms, which it achieved in 1995. In 1996, the UNDP and government began designing a national-scale project. In 1998 they conducted evaluations that convinced the government to commence a full-fledged program the following year; it would be managed by the Mali Department of Industry and Commerce as executing agent, with co-financing by the Norwegian government and a total budget of \$2.5 million [20]. The Mali Ministry of Youth Promotion, Department of Planning and Statistics, and Ministry of Local Development devised strategies to disseminate platforms to women and children [4]. As one respondent explained, "the primary driver behind the MFP was to help women overcome their daily challenges, and it was organized around the twin pillars of gender empowerment and microenterprise establishment."

The MFP technology consists of a small 8–12 horsepower diesel engine (approximately 7 kW) mounted on a chassis, to which various components can be attached, such as: grinding mills, huskers, straw shredders, battery chargers, vegetable or nut oil presses, welding machines, and carpentry tools. The engine can also generate electricity through mini-grids for lighting, refrigerators, and electric pumps for water distribution and irrigation [18,19]. Some even use the MFP to manufacture liquid fuel for transport. The platform itself is both simple and flexible: it is easy to operate, capable of being made and maintained locally, and able to support a variety of different activities and groups. It can even provide some services simultaneously. For example, the engine can operate a water pump producing eight cubic meters per hour, a mill rated at 150 kg per hour, a battery charger, and light 180 bulbs at the

same time. However, "simultaneous multifunctioning" is not possible for welding, rice hulling, and mechanical saws [18]. On average, each platform supports about 800 clients per month and costs \$4200 to \$4600, inclusive of all equipment and training [21]. Fig. 1 shows a schematic of a typical MFP; Fig. 2 shows an actual platform in use in Mali.

At least four things, apart from the functionality of the platform, make the MFP distinct from other energy development projects. First, the government adopted a "softly, softly" approach, minimizing public involvement and relying on communities and local women's groups to take charge of implementation [4]. Second, the financial model of the MFP was based on cost-sharing: the project provided grants of up to \$2500 for platforms and as much as \$10,500 for mini-electric grids or water networks. Women's groups, however, and communities were expected to finance 40 to 60 percent of equipment costs for platforms, and assume responsibility for depreciation, maintenance, salaries, and operation [19,20]. In actuality, subsidies and grants from the project covered slightly more of its costs than originally anticipated: these payments covered about 60 percent of a project in 1999 and 73 percent in 2004. For mini-grids and water networks, the subsidy covered about 80 percent of project costs [22]. Third, the MFP targeted women. Instead of asking communities to request MFPs, the strategy was to seek out women's associations and include their participation as a condition of ownership. Fourth, and most importantly, the MFP embraced an eight-stage sequential model that involved feasibility studies, training, monitoring, and evaluation, summarized by Table 2.

5. Benefits of the MFP

Though not without its challenges (described in a later section), the MFP has been an almost undeniable success. In 1999, during the first year of the MFP's nationwide operation, the government installed 48 platforms and trained 240 people on how to operate them. The program also educated 47 male artisans in mechanical and electrical installation, welding, and maintenance. By June 2001, the program installed 149 platforms, benefitting about 100,000 women. By the time the program finished in December 2004, 514 platforms were installed, which exceeded the program's target. These platforms represented a \$10 million investment and served an estimated half a million women or 5 percent of the entire rural population—mostly in the Southern regions of Sikasso, Segou, and Mopti [19]. President Alpha Oumar Konare endorsed the platforms in a national campaign to fight poverty, and in the final two years of the program, more than 1500 villages made requests to participate

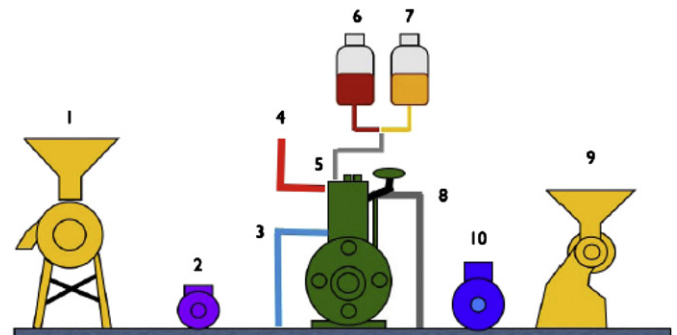


Fig. 1. Schematic of a Multifunctional Platform (MFP). Source: [21]. Legend: 1: Cereal mill and nut grinder; 2: Direct current automobile alternator for battery charging; 3: Cooling water inlet; 4: Cooling water outlet; 5: Lister 10 HP Diesel engine; 6: Diesel fuel reservoir; 7: Jatropha oil reservoir; 8: exhaust pipe; 9: Thresher alternating current asynchronous generator.



Fig. 2. An MFP in use near Mopti, Mali. Source: [21].

in the MFP—implying that demand far outpaced supply. Based on a post-project survey of 158 platforms completed in 2006, most MFPs in Mali provided two to three consistent services (81.2 percent), with 11 percent providing only one service and 7.6 percent providing more than four services [22]. Nineteen of the surveyed platforms were equipped to deliver drinking water and seven provided electricity through mini-grids. Table 3 breaks down their services provided.

The MFP approach has expanded in Mali and throughout the region. Under a separate project managed by the government that commenced in 2007, more than 600 platforms have been installed by 2009, 1200 platforms by 2011, and an estimated 1800 platforms are expected to be installed by the end of 2012. Bilateral development agencies in Denmark, France, the Netherlands, and Norway—in addition to the Bill and Melinda Gates Foundation—contributed \$20 million in additional funding, and MFPs served about 1.5 million people throughout Mali in 2011. Based on the MFP in Mali, other West African countries including

Burkina Faso, Ghana, Senegal, Guinea, Niger, and Togo have all started their own national programs, collectively providing energy services to 3 million people [23]. The MFP is also part of an integral \$28 million Mali Household Energy and Universal Access Project, which began in 2009 and is being managed by the World Bank office in Mali; it is expected to end in 2013 [24].

Indeed, the UNDP's own review of the MFP noted that, at the time of the project's close in 2004, 96 percent of the requesting communities in Mali could afford platforms, and 100 percent had positive cash flows before amortization—that is, under current conditions communities were not undertaking debt. Thirty to 80 percent of women in each community reported using the platforms, 99 percent of its overall beneficiaries were women, and the MFPs linked to water processing units had 100 percent payment collection rates. One interview respondent also noted a positive change in reduced technology costs:

We knew that to get the cost of investment to decrease, we needed economies of scale and sufficient capacity to establish learning curves. We aimed for a project at the national level so that investment costs would go down in Mali. And it did: as the MFP expanded, capital costs for systems started to decline, as well as the cost of energy delivered, even training costs. By our estimate, the technology and training cost 40 percent less by the end of the program, as compared to the program's beginning.

This section shows the most substantial benefits from the MFP, including expansion of energy access, income generation, women's empowerment, improved education, enhanced food security, and community cohesion.

5.1. Expansion of energy access

As mentioned above, the most direct benefit from the MFP has been expanded energy access for about 500,000 women or 5 percent of the entire rural population 2004, roughly 1.5 million individuals throughout Mali. To put the value of this energy access in perspective, consider two statements, one from villagers before

Table 2
Eight-stage model for MFP dissemination.

Sequential phase	Description
Selection of a women's group	Assesses demand for an MFP by receiving requests from registered entities such as village women's associations and groups
Pre-feasibility studies	Conducts participatory social, economic, and technical feasibility studies to ensure the basic conditions for MFP performance are present
Configuration of the platform	Configures the platform to specific village needs, including the positioning of end-use equipment and the level of energy services villages are able and willing to pay for
Financing	Cost estimates are distributed to the women's group, which then mobilize funds to acquire the platform (minus project subsidies) and then elect management committee members, who will oversee platform operations and settle disputes
Operations training	Trains the members of women's associations in managerial skills to ensure the technical viability of the platform
Business training	Trains the members of the women's associations in market-based business approaches and strategies to maximize cash flows from the platform
Manufacturing and maintenance training	Builds the capacity of local machinists and artisans to purchase, install, repair, and maintain platforms
Monitoring and evaluation	Monitors technical and economic performance and provides advice to overcome difficulties

Source: Modified from [19].

Table 3
Overview of energy services available at MFPs.

Type of service	%
Cereal grinder	98.1
Nut grinder	36.9
De-husker	32.9
Battery charger	32.9
Generator	7.6
Welding set	3.8

N = 158. Source: [22].

a MFP and one after. As one group of women in Maourolo explained in 1998, before the MFP reached them:

At this moment it is harvest time, we spend all our time until well after dark in the fields. Tonight the children will go to bed without food, and the men will go back to the fields without breakfast. You see, we do still have cereals in the granary, but we simply do not have time to grind and cook food. We are exhausted. Tomorrow, we will stay behind and find the energy to prepare lunch to take to the men and the other women in the fields. They won't be able to work as they need to on an empty stomach. [18]

This contrasts with what one interview respondent told us about Maourolo today. According to them:

The MFP has completely changed villages in Mali such as Maourolo. Women now have extra time for leisure and entertainment, children are well fed, men are better clothed. People can walk the streets at night, and they have more income (and time) for health care, education, and work.

The MFP has brought positive changes such as these to hundreds of villages throughout the country.

5.2. Income generation

Every single MFP monitored up to 2004 had positive cash flow, and the platforms have provided new income opportunities for community members related to rice hulling, shea nut grinding, small-scale farming, and artisanal carpentry. The UNDP's 2004 assessment calculated that women earn on average \$44 per year in additional income, as well as two to six extra hours of time per day [19]. A follow-up assessment calculated \$68 in additional revenue per year per family—a significant amount of extra income given that the average household lives on \$1.37 per day [6]. (Keep in mind that the above statistic is the average yearly income for all women, inclusive of those not participating in the MFP—incomes of women in MFP groups are often higher). The UNDP assessment noted that 70 percent of Malian women interviewed reported an increase in revenues. The increase in revenues was largely the result of greater productivity from agricultural processing, better quality products (enabling women to fetch better prices), and time savings that enabled women to devote more time to other educational and income-generating activities, such as maintaining their own individual farms, diversifying their crops, and starting small enterprises

in agricultural and fishery products trade [6]. The assessment also estimated that, on average, 205 women per village become “economically active” after the introduction of an MFP.

Fig. 3 shows the annual average revenues from the marketing of foodstuffs in twelve Malian villages, and demonstrates that those revenues increased for individual women significantly—sometimes quadrupling—after receiving an MFP. Other studies have shown that women utilizing MFP to sell shea butter increased their annual incomes by a factor of three [25].

The 2004 UNDP assessment concluded that if every village in Mali were to receive a platform, and if each platform would serve 205 women, \$41 million to \$59 million in financial gains would occur country-wide. Interestingly, when adjusted for purchasing power parity, this amount equates to each individual earning about \$0.32 of additional income per day—almost equivalent to the country's poverty gap ratio (the mean shortfall of the total population from the poverty line) of \$0.37 per day [6]. The implication here is that universal access to MFPs could almost single handedly reduce the prevalence of rural poverty.

Furthermore, the benefits of MFPs are not limited to women. Men benefit as well, and some have utilized their extra time and resources to start battery charging stations for mobile phones. (Fig. 4 shows one such enterprise near Bamako) [26]. Other men have started carpeting workshops, carpentry firms, telephone booths, and night-illuminated convenience stores. Kary Lait in Markacoungo, for instance, does more than one vocational activity and uses his family's share of energy from the MFP to produce and sell yoghurt, ice fresh and fermented milk, cool ginger juice, and soft drinks, and to charge batteries for mobile phones [26]. Another study noted that the income generated by MFPs was spread almost evenly across the various services of milling, de-hulling, grinding, and battery charging [23]. Men also benefit indirectly from the MFP, because it enables more timely meal preparation, increases the availability of beer brewed using milled grain, and enables women to focus their time and energy on other family tasks [20].

5.3. Women's empowerment

The MFP in Mali has empowered women by lightening their workload, improving the efficiency of water collection, and enabling their participation in the local economy. In Mali, it is generally women and young girls that must handle domestic chores such as grinding cereals and hauling water [25]. On average,

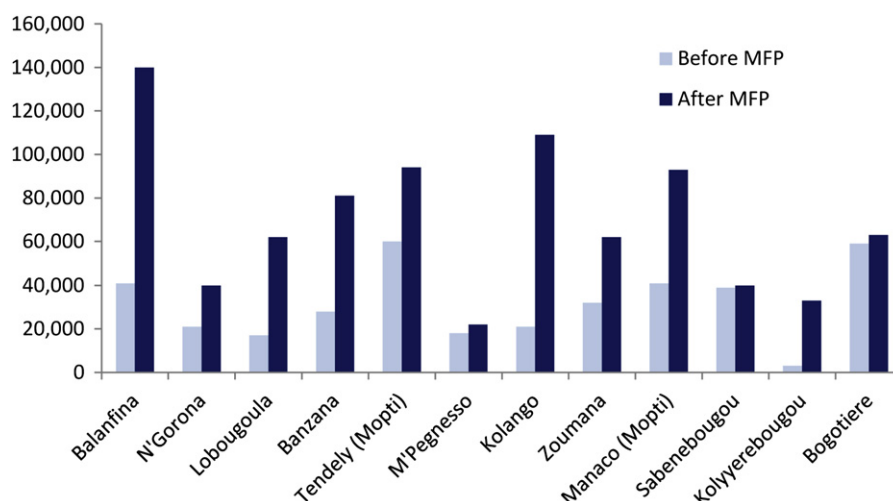


Fig. 3. Average village revenue (CFAC per woman per year). Source: [6]. Note: CFAC = African Financial Community Franc (*Communauté Financière Africaine Franc* in French). As of April 2012, 1 USD = 485 CFAC.



Fig. 4. MFP-based charging station for mobile phones.

these chores take many hours per day, yet an MFP tends to free up 2 to 6 of these daily hours [19]. The time saved for mechanical shea nut crushing alone is 3 h and 45 min; the time saved for processing 28 kg of rice amounts to 12 h [25]. When entire families, rather than individual women, are taken into consideration, the platform can save upwards of 30 h per day. In the village of Bogotiere, for instance, it is common for 16 women to grind cereals for that family's daily consumption. With access to an MFP, these women can save nearly 2 h each, so that a combined 32 h of time can be spent doing other things [6]. Collectively, the UNDP estimates that the MFP saves roughly 75 million hours of time per year [6].

The platform also gives women more choices in determining how they use their time. This often has the effect of making their previously invisible efforts visible to men, enabling them to gain recognition and social standing. Women become more literate, refine their bargaining and negotiating skills, and learn to conceive and implement business plans through the MFP approach. As one study concluded, "the creation of a decentralized energy enterprise owned and managed by women can generate strong dynamics for structural transformation in a setting where land and agricultural based assets are primarily owned by men and tasks are performed by women as unpaid obligations to men" [20]. In some villages, women are compensated with land for operating and maintaining the MFP, giving them access to individual farming plots that they can use to grow food and eventually pass down to their children [20].

5.4. Improved education

The educational system in Mali has been described as "among the least impressive in the world." Roughly 70 percent of the population never completes their schooling due primarily to the opportunity costs involved, negative perceptions of teachers, and reductions in public expenditures on primary schools [6]. However, communities that embrace the MFP tend to have increased levels of girls' attendance, improved performance, and drastically improved boy-to-girl ratios in schools, as shown in Fig. 5—which shows such

improvement in all but one village. Communities receiving MFPs have also been documented to have lower drop-out rates, higher test scores, and higher proportions of girls entering secondary education—increasing 31–38 percent across the sample of 8 villages [6].

5.5. Enhanced community resilience

Though this is a difficult benefit to quantify, communities possessing MFPs are also more resilient to food shortages and natural disasters. Mali is highly dependent on agricultural earnings, with 90 percent of rural villages dependent on agriculture as their predominant source of income [4]. MFPs help make the agricultural sector more immune to natural and economic shocks by improving community health, reducing economic dependency on farming during the dry season, raising the total net income of households, and strengthening women's participation in community decisions [19].

Fig. 6, for example, shows women preparing to store grain processed from an MFP for the dry season. Although not the only causal factor, there is evidence to suggest that agricultural productivity and sustainability did improve in tandem with the implementation of the MFP across the country [27]. The MFP program in Ghana has also been linked to the strengthening of the national agricultural sector by improved processing times and financial viability [28].

MFPs benefit communities by expanding employment opportunities for men and women because they enable battery charging operations, as well as welding and equipment fabrication for ploughs, carts, and grinding. Additionally, the ability for MFPs to improve adaptive capacity and resilience will become even more salient as rural communities begin to confront more severe droughts arising from climate change, desertification, soil erosion, and water shortages [15,17,29]. Furthermore, one interview respondent noted the MFP reduced water borne illnesses at the village level due to its ability to pump cleaner subsurface water. The MFP has the added benefit of increasing energy and water access

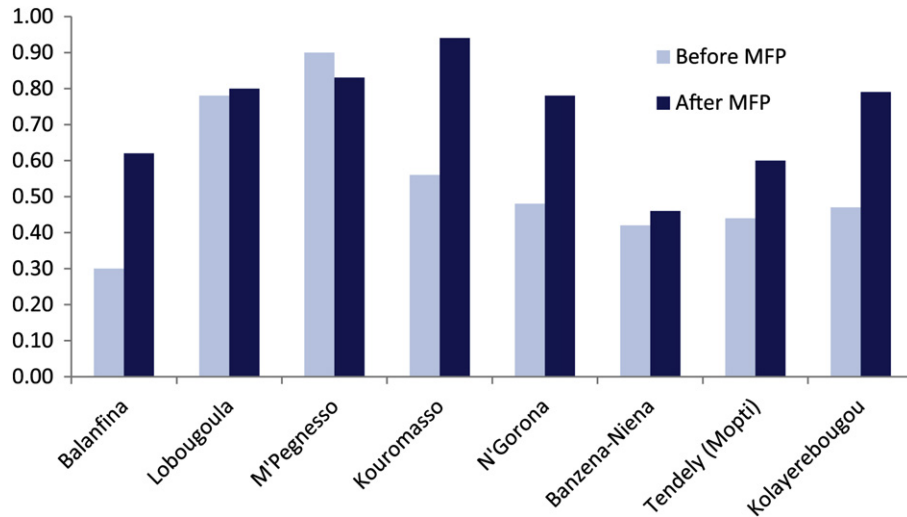


Fig. 5. Girl-to-boy ratios in select Malian primary schools. Source: [6].

while not contributing significantly to the causes of climate change. As one respondent iterated, “though fossil fueled, MFPs are not a major contributor to climate change, because the diesel engines operate more efficiently than fuelwood or older generation sets. We estimate that a community adopting an MFP increases its carbon dioxide equivalent emissions by less than 0.8 percent after MFP adoption.”

6. Challenges to the MFP

Notwithstanding the aforementioned five benefits, this section presents five sets of interconnected challenges identified by our respondents and the literature: idleness and maintenance, policy coordination, poverty and financing, dependence on imported fuels and technology, and patriarchy.

6.1. Idleness and maintenance

MFPs are more complicated and more difficult to operate than ordinary diesel generators, solar home systems, or microhydro dams. A diagnostic evaluation of the MFP conducted by Engineers Without Borders of Canada noted that systems throughout Mali had battery chargers that were “systematically non-functional,” which made local grinding mills consistently crack and break. Additionally, a vast majority (90 percent) of air filters on the diesel engines were not properly maintained and cleaned [30]. Most Anil, Rhino, and Lion motors are “robust” enough that they continue to operate despite this poor maintenance, but the assessment concluded that “very few villages practice preventative maintenance.” Parts are often replaced only after they break, and in some cases, repair costs of poorly managed systems can offset gains in income [30]. Another assessment of the technical performance of MFPs throughout Western Africa, which was released in 2009,



Fig. 6. Processing food with a MFP for storage.

noted the “poor finishing and quality of materials” used in attached equipment such as cereal mills and de-huskers, errors in construction, and a lack of spare parts in rural areas [23]. Fig. 7, for example, shows a system undergoing inspection and repairs in the Ségou region of Mali.

Indeed, these types of technical problems have resulted in poorly functioning systems and have eroded some of the gains the original MFP project made when it finished in 2004. One independent evaluation team visited all 514 MFPs in Mali one year after the project ended and noted that roughly one-quarter were non-functional (see Table 4). The most common explanation given for non-functioning systems (48 percent) were “social problems” such as lack of motivation on behalf of the women’s association, clients unable to capitalize on the free time created, low levels of pay for MFP employees, and conflicts over gender roles and gender empowerment (e.g., men resisting the enhanced social status of women). The second most common explanation (23 percent) was “technical problems” such as a lack of mechanics, dishonesty or overcharging on the part of the mechanics, and turnovers in village leadership that left those without formal training in charge of the platform. Other assessments have noted that between 35 percent to 40 percent of MFPs were not operating a few years after their installation [22,31]. One of these assessments noted that although 56 percent of platforms were equipped with battery chargers, only 14 percent of them were in operation [22]. Similar problems have occurred in Ghana, where only 32 of 40 MFPs are still working a few years after their program ended [32].

Three other factors beyond social and technical problems may explain the non-functionality of some platforms. First, in some communities the very flexibility inherent in the MFP becomes a curse rather than a blessing. Integrating functions into a single platform means that when the engines are down, the community loses *multiple* energy services at once. This can in some cases actually lead to the “increased vulnerability” of a village [22]. Second, MFPs can only produce a few of their total services at one time, and these may require particular sequencing or may be situated at different locations. This means that systems will remain idle while being disassembled, transported, and reassembled throughout villages, and also that services will be limited to

Table 4

Functional and non-functional MFPs in Mali.

Region	Functional	Non-functional	Not started	Total
Kayes	12	2	5	19
Koulikoro	16	4	0	20
Sikasso	170	42	8	220
Segou	73	47	14	134
Mopti	49	43	29	121
Total	320	138	56	514
Percentage	62%	27%	11%	100%

Source: [30].

a particular time—e.g., cereal grinding in the morning, nut crushing in the afternoon, and electricity generation in the evening [22]. Reaching community consensus over the “correct” type of sequencing can be difficult to achieve; in this case, community ownership becomes subject to the dilemmas of collective action. This could be why women’s groups chose to have an average of just 2.4 services per platform on the 514 MFPs implemented in Mali. One critique of the MFP therefore suggested that single-purpose implements and private ownership by individual households might be a better option than multipurpose implements owned by women’s groups [22]. Third, MFPs might simply be too large for some communities. As one respondent explained, “MFPs sometimes provide too much energy—so much that communities do not know how to use them, operators only run them half or a third of the time. This implies the need for more training, for more hours of operations, connecting MFPs to larger enterprises such as hotels or restaurants, or leasing out systems to other villages.”

6.2. Policy coordination

Planners and the government have faced difficulty integrating the MFP program into other areas and sectors, such as the country’s industry or commercial development plans, and the country’s national statistics do not take into account the time and other gendered dimensions of rural poverty. As one respondent criticized, “There are still no clear benefits to MFP projects. Implementation of the MFP is difficult because project managers expect the MFP to solve so many issues.” Furthermore, though the MFP reached 514



Fig. 7. An MFP being repaired near Kondogola, Mali. Source: Alassane Agalassou.

villages as of 2004 and is set to reach 1800 villages by the end of 2012, there are more than 11,000 rural villages in Mali [35]. Many of these villages are economically, socially, and politically “remote and isolated,” and characterized by “inadequate physical infrastructure and lack of access to basic services such as water, health, education, electricity and telecommunications”—implying that the government has a long way to go before it can deploy a platform in every village, especially given the political turmoil in 2012 [26]. As one study also concluded, the women’s groups for villages that did have platforms received adequate training, but few entrepreneurs received any assistance at all and men’s associations—those involved in battery charging stations, hardware stores, and other vendors—“received almost no support” [26]. If the government is to continue disseminating platforms to villages, it may need to (a) harmonize its development and poverty plans to coincide with the promotion of MFPs, (b) systematically target the thousands of villages that still lack access to a platform, and (c) consider giving support to other stakeholders besides women’s groups.

6.3. Poverty and financing

The endemic and widespread nature of poverty in Mali does make it difficult for platforms to generate incomes. Most local markets, for example, have “limited scope for revenue growth” given that their customers are “extremely poor” [6]. The villages adopting platforms so far have mostly had to pool their assets and finance, all on their own, up to 60 percent of the costs of the MFP. Thus, the MFP is inherently unavailable to villages that lack such assets. Moreover, the state of rural financial and micro-financial institutions in Mali remains limited. As one study warned, currently “there are no intermediaries at present with knowledge and know-how in managing energy loan programs at the local level” [6]. One of our participants also commented that “it is difficult for some villages to afford an MFP even though they could benefit from one.” Consequently, one respondent summated, “the MFP has targeted villages with the capacity to request an MFP, raise money for it, and band together to operate it—but in Mali, these types of villages are the exception, rather than the norm. In a way, it has therefore benefitted the wealthier and more capable villages but excluded the poorest and most in need.”

6.4. Dependence

Both the diesel generator and the diesel fuel that runs most MFPs in Mali must be imported—the generators often from India and the fuel from Mali’s neighbors. The newest projects being installed now frequently run on jatropha oil, [33] but even these require technical support from abroad. As one interviewee criticized, “The MFP is fossil fuel dependent, needs spare parts and maintenance operations, and is not friendly-environmentally. Nowadays (and even 15 years ago when the project started) there are better distributed energy generating solutions.”

6.5. Patriarchy

Respondents lastly identified the patriarchal nature of Malian society as a significant barrier towards both true income generation and gender empowerment. As one explained, “I know of a few villages where the MFP resulted in a cultural backlash: men resented women gaining power, and in some severe cases harmed them physically for contemplating taking a part.” A second participant argued that “Mali is an extremely patriarchal society where women are not allowed to drive a motor bike nor are they allowed to have a car, it’s nonsensical to think that men will suddenly let them manage and operate complex electrical equipment.” Another

commented that “though rare, in some villages the MFP may have actually increased workloads for women, since men would expect them to fulfill all of their ‘ordinary’ responsibilities in addition to whatever ones they accrue due to the MFP.”

7. Conclusions and lessons learned

The MFP in Mali offers six broader lessons and one caveat for energy and development practitioners.

7.1. Cross-sectorial approach

The most distinctive lesson learned is the cross-sectorial approach of the MFP targeting energy access, gender empowerment, and enterprise establishment. As one respondent stated:

The technology of the MFP was innovative because it brought various systems and applications together, and integrated them into a single platform. Dissemination was innovative because this platform was delivered not to electric utilities or businesses, but women and very small enterprises. The approach was innovative as it focused on a nexus between agriculture, energy, and enterprises—cutting across the domains of food, processing, industry, rural growth, and social development.

The underlying lesson here is that energy access projects work best when they couple that access with productive uses, income generation, and elevating the social and economic status of underprivileged groups. Even though the technology in some cases may have been “wrong” since MFPs depend primarily on diesel fossil fuel, the approach at delivering it, and focusing on things like cost-sharing, governance, gender, and empowerment, was “right.”

7.2. Feasibility and scaling up

The MFP demonstrates the utility of starting with feasibility studies and piloting phases before scaling up to the national-scale. The UNDP and other stakeholders first conducted a pilot phase of the MFP that distributed four platforms from 1993 to 1995. After the pilot phase, distribution started slowly in the south of the country in 1999 before expanding nationwide. Before a platform is installed in each village, multiple feasibility studies must be done looking at village resources as well as the strength of women’s groups. As one assessment has explained, “the participatory and feasibility study helps each village define the components of its platform on the basis of its priorities and its technical and financial capacities. It also helps the project identify specific baseline indicators (economic, technical, and social) for each community” [25].

7.3. Capacity building

The third most salient lesson relates to capacity building: the MFP implies that capacity building should always be done, and done at multiple scales in a sequential order. As Table 5 illustrates, the eight-stage implementation approach of the MFP in Mali actually built capacity at different scales, affecting different actors. When expenditures on these capacity building efforts are aggregated, the MFP project spent more resources on them than on actual hardware: approximately 57 percent of project funds per platform went to the feasibility studies, training, and monitoring, and 43 percent went to equipment and hardware [21].

As one respondent expounded:

Capacity building is a major strategy that planners must never forget to implement. It must never be taken for granted, and without assisting the government and private enterprises, any

Table 5
Capacity building undertaken as part of the Mali MFP.

Type of capacity building	Beneficiary	Results
Feasibility study	Buyers and managers of platforms	Ability to make decisions on the acquisition of a platform
Operation and management of the platform	Women's management committees (on average eight per platform)	Ability to manage and operate platforms and present results to the Women's Association
Literacy and numeracy	Women's management committees and operatives (about 20 per platform)	Effective use of bookkeeping and record keeping
Entrepreneurial activities	Women's committees (on average eight per platform)	Diversification of employment, increases in community income, and increased time saved by clients
Manufacturing	Fabrication artisans (about 1 per every three platforms)	People able to produce batches of platform parts and components
Maintenance	Maintenance artisans (about one per district)	Reduction of downtime and effective preventative servicing
Awareness raising	Government officials	Knowledge about how the MFP operates and harmonization with national poverty objectives

Source: Modified from [20].

project like the MFP will be short-lived. All stakeholders must be involved—from the national government to the local women's groups. In that vein, at the village scale, we did feasibility studies to see which villages might be interested in MFPs, as well as which would have key features such as available space and provisional financing. We trained women and entrepreneurs in how to operate and maintain the system, as well as how to manage a bank account, how to budget money, a whole process of literacy. We trained them in enterprise skills such as marketing and business, a very long process to ensure that project developers could manage both the technical and economic aspects of their systems by themselves.

One of our other respondents commented that the MFP was so successful because it was implemented with a “complementary educational program so people can both learn about the MFP and how to maintain it, and also learn about business models and how the economic gains derived from the MFP can improve their lives.” These statements underscore the holistic nature of capacity building undertaken by Mali MFP project planners.

7.4. Community ownership

Rather than give away platforms for free, the MFP required that communities—in particular, women's groups—own them and contribute the resources to cover a large share of costs. Communities themselves were made responsible for maintenance, salaries, and tariff collection. That process ensured that communities took an active, rather than passive, role in delivering energy services. It also ensured that costs were shared. As one respondent put it, “at the beginning, the MFP was dependent almost entirely on grants. By the close of the project, most financing was done by the communities themselves and small banks—meaning they became

serious about ensuring that the platforms succeeded technically and economically.” The project has been so successful that it is constrained not by demand (there is a long waiting list) but the availability of funds to pay for the machines and the time needed to train operators.

7.5. Flexibility

The MFP was intrinsically flexible and simple, a “truly appropriate” technology capable of meeting the demand for a variegated set of energy services. This occurs across both inputs and outputs of the system. In terms of inputs, one respondent noted that:

The MFP has flexible fuel sources, in that the platform could run not only on diesel or kerosene, but also on jatropha oil that did not need to be processed or distilled. Liquid straight from the seeds could fuel the system, minimizing dependence on imported fuel. Some are even using microhydro configurations to power the platform. That's the beauty of the MFP: it's inherently flexible. Its energy source can be anything from a diesel engine to moving water and even wind and sunlight.

In terms of outputs, another interview respondent argued that “the MFP is an integrated development project that can be done at the decentralized level, and there's not a lot of energy that can be used that way. Farmers at a very low level of education can get involved in the process, it doesn't require a lot of knowledge or technology.” The MFP allows several pieces of equipment to be combined or arranged to meet the needs of distinct groups; its operating hours can be flexible based on these needs, for example pumping water or grinding cereal in the morning but providing electricity for lighting at night; and it can provide some of its services, such as battery charging and milling, simultaneously [19]. Or, as one respondent put it, “one of the biggest lessons we can take away from the MFP is that instead of making something that is easy to sell to development donors, we should think more about what would be a huge benefit to users, focusing on the services they want.”

7.6. Political leadership

The MFP demonstrates the necessity of having strong project leadership—in this case a dedicated agency, the Department of Industry and Commerce, in charge of project management with backing from the President and international organizations such as the UNDP and UNIDO. As one respondent elaborated:

The MFP reminds us that for any program involving extremely poor communities, public investment is essential. The private sector won't do it alone, nor will the communities themselves. Getting the government on board, and committed, is the key to unlocking everything else. Government leadership in the case of the MFP jumpstarted private sector investment and facilitated community involvement—it essentially reduced the risk so that these other actors could become involved.

This type of sustained leadership can be instrumental in overcoming obstacles and ensuring implementation targets are met.

7.7. Caveats

The MFP lastly raises some enduring questions about energy development policy. One is that the project accomplished all of its goals without a credit line or financing; this was left for the communities to acquire themselves, somewhat going against the

conventional wisdom that projects need to offer financing in order to overcome the first-cost hurdle with energy equipment.

Another implication of the MFP is that there is a troubling number of non-functioning platforms within Mali—roughly one-quarter as of 2005. This may imply that one of the most supreme challenges in decentralizing energy access away from national utilities and private companies to villages is the process of decentralization itself. In order for the MFPs to work, women's groups need to perform preventative maintenance and possess the acumen to realize when repairs are needed; mechanics need to be able to service platforms; spare parts need to be available; and local clients need to demand energy services. A kink in any one of these chains could result in a non-functioning platform, and serves as a reminder that implementing projects such as the MFP must overcome incredible challenges in order to meet their targets.

Appendix

Ecole Polytechnique Fédérale de Lausanne.
Economic Community of West African States.
Malian Agency for the Development of Domestic Energy and Rural Electrification.
Mali-Folkecenter.
Sherbrooke University.
Technical University of Denmark.
Universidade Nova de Lisboa.
United Nations Development Program—Mali.
United Nations Development Program—New York.
United Nations Development Program—Regional Center, Bangkok, Thailand.
United States Agency for International Development.

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