

# Rural community perception of fuelwood usage by families living in Wassorola, Mali: Interview with women as main fuelwood collectors

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**Abstract.** Fuelwood used for cooking occupies almost 90% of the total energy used in Mali. A consequence of this widespread usage of fuelwood is the shrinking area of Malian forest. Unfortunately, several projects to address fuelwood issues have failed because of misunderstandings between project managers and local people. This paper aims to highlight this situation by presenting the perspectives of the local people, for whom fuelwood is an integral part of their daily lives. Rural community knowledge will help to establish a mutual understanding between the people of Wassorola and development organizations or project managers. Surveys were carried out to gather respondent answers on fuelwood issues, such as frequency of fuelwood collection, and types of stove. We performed principal component analyse (PCA) in order to determine variation in the data set. Family units in Wassorola consist of extended families with an average of 6.7 adults and 6.5 children. The education level of interviewees is low: 84% never attended school. Of the respondents, 83% are aware of the threat to their forest resource and 12% think there is no solution to the problem. Result of PCA shows that, PC1 explains 28.84% of variance and cumulative portion of 76.67% variance is explained by PC1, PC2, PC3 and PC4. The variables of level of education and capacity to write and read have highest absolute value of loading in PC1. The variables numbers of people living as stakeholders, and the reason for changes in the forests surrounding them have the highest value of loading in PC2. PC4 shows that the variables of type of stove and reason of forest changes of forests are change together.

**Keywords:** Principal component, fuelwood, education, Mali.

## INTRODUCTION

Fuelwood is an important source of energy for many people throughout the world. A projection for the year 2000 suggested that 200 million people would face fuelwood crisis in world (FAO, 1981). The announcement of the crisis raised the perception that African forests would be decimated to provide fuelwood to rural people (UN, 1981). Fuelwood provides 89.1% of the energy consumed by Malians (CCL, 1999; SED, 2000; DNCN, 2007). It is used mainly for cooking and boiling water during the cold season. In rural areas the per capita consumption of

fuelwood in Mali ranges from 291 to 574 kg per year (Morton, 2007). Under maximum consumption, 0.35 ha of woodland is needed to meet the fuelwood demands of one person per year (Morton, 2007). The result of this aggressive demand for fuelwood to meet energy needs is shrinking forest areas: during the period 2000 to 2005, Malian forests shrank by 6% (FAO, 2007). If that trend continues, the country will face a fuelwood crisis within the next three decades (Diarra, 2002).

The fuelwood problem is not recent. It became severe

after 1950's (IBRD, 1984). Research, projects and programs were set up to address fuelwood problems in the developing world (Inge, 1997; Horst, 2009). These different attempts to solve the fuelwood problem failed (Mahiri I, 2001). For example, the Malian government set up reforestation projects and introduced an improved stoves program, to stop the loss of forest, but the forest area still decreased in Mali (DNCN, 2000; DNCN, 2007). The reasons behind these failures are described below.

Reforestation is one potential solution to prevent a fuelwood crisis. It aims to increase fuelwood stock by planting trees to produce fuelwood. In Tanzania, the scarcity of fuelwood in many regions encouraged intense reforestation for fuelwood production. From 1975 to 1981, the planting area increased from 3,280 to 12,050 ha (IBRD, 1984). However, reforestation fails to solve the fuelwood shortage because it is a complex problem that needs to be solved by striking a balance between output and input of fuelwood stock (IBRD, 1984; Dewees, 1989). In theory, reforestation projects should solve the fuelwood crisis in developing countries. However in Mali, reforestation fails to solve the crisis due to the following reasons: 1) the planted species (*Azardicaindica*, *Eucalyptus* sp.) produce poor-quality fuelwood and are smoky and malodorous; and 2) local species (*Acacia seyal*, *Acacia nilotica*) require a long growth period before they can be harvested for fuelwood (Tiffen, 1994).

Another potential solution to solve the fuelwood problem is to introduce stoves that consume less fuelwood. Several types of stoves were developed and introduced to rural people. Unfortunately, these stoves were expensive and were not suitable for the villagers' way of cooking. Instead, the people continued to use the three stone fire-places seen in most households (Jones, 1988; Clarke, 1985).

Some authors (Sachs, 2005; Collier, 2007) have criticized western countries for, setting lofty goals to help developing nations ("end poverty, "war on poverty", "make poverty history," "sustainable use of environment everywhere"). These goals would likely yield unsatisfactory results because the poor cannot relate to them (Easterly, 2006). Goals should come from the bottom up. In 2005, a Cameroonian journalist protested against the organizers of the Live 8 concert (a concert to lobby G8 leaders to increase the aid budget), saying that "they still believe us to be like children that they must save" with "their willingness to propose solutions on our behalf" (Easterly, 2006). There have been countless projects in Africa that failed because local people were not included as decision makers in the development of the projects. To avoid such failure, this paper presents the viewpoints of people whose daily lives depend on fuelwood. Knowing their point of view will allow establishment of a mutual understanding between the villagers of Wassorola and development organizations.

The aim of this research then is to highlight Wassorola community perceptions on fuelwood problems. In order to

do so, we address specific aims, such as describing the characteristics of people living in Wassorola, their awareness of changes in the surrounding forest, the different cooking devices used by local people and the reason for adopting those cooking devices.

## METHODOLOGY

### Study area

Mali is a landlocked West African nation; it is surrounded by seven countries. It has a population of 12 million; 80% of whom live in rural areas. Rural people in Mali are mainly farmers, herders and fishermen (CPS-MDRE, 1999).

Fuelwood stock is linked to vegetation type. Following are the different climates and vegetation types in the country:

1. The Sahara Desert is in the northern part of Mali, and occupies about 57% of the nation's territory (DNCN, 2002; MEA, 2005). In this climate, fuelwood production is negligible.
2. The Sahel covers the middle part of the country and accounts for 18% of Mali. It has a fuelwood production of 10 to 12 m<sup>3</sup>/ha (MEA, 2005).
3. The Soudan region vegetation occupies 14% of Mali, and Wassorola is located within this region. Fuelwood production is 30 to 45 m<sup>3</sup>/ha (MEA, 2005).
4. The Guinean Savannah has the greatest density of trees in Mali, with a fuelwood production of 60 to 80 m<sup>3</sup>/ha (MEA, 2005).

Wassorola is 20 km from Bamako, the capital of Mali, and was chosen as a research site because it represents the typical village in Mali with the Sudan vegetation type. The village is located at 12°49' N and 8°07' W and has a Sudan-climate, with a three months of rainy season and a 9 month dry season. The annual temperature range is from 20 to 45°C (MEA, 2005). The vegetation in Wassorola is savannah dominated by shrubs. The village population is estimated to be 2,000 people who earn their living via agriculture, herding (cows, sheep and goats) and selling forest products such as fuelwood and shea butter (USAID, 2008).

### Survey design

We reviewed the literature and focus groups to identify the main points to address villagers' opinions. The chief of the Wassorola women's association and coordinators of projects (environment and poverty) and coordinators of projects (Strategies for domestic energy) participated in the focus group work. The major themes identified in focus group discussions were: The local people's point of

**Table 1.** Name, label and scale of variables.

Variables	Label	Scale
Number of people living in family	Numb of People	
Can you read and write?	Read/write	1-3
Have you been in school?	Education/level	1-3
How have the forest resources changed	Cmt-frt-chge	1-4
What is the main reason for the changes in the forests resources	Rsn-chgmt	1-4
Which type of stove do you use to cook?	Type-stove	1-5
How many times a day do you cook?	cooking time a day	1-4

**Variables:** different sociology parameters in our interview **Label:** different abbreviation in our statistical analyses.

**Scale:** values according to respondents answers in our statistical analyses.

view on change in vegetation in the surrounding forest, household way of cooking, fuelwood consumption and acquisition. In January 2010, a survey of 100 people was carried out to assess village opinions on the fuelwood issue and the lifestyles of the villagers of Wassorola. Interviews were conducted face-to-face and the respondents' consent for an interview was not obtained in advance. We approached each household and briefly explained objectives of the survey. If a householder declined to participate in an interview, we moved on to the next household.

### Setting and sample

Only women participated in the survey because men declined to participate in the survey, stating they thought women were more suitable to answer questions that were mainly related to cooking.

We chose Wassorola as the survey site because it is a typical Malian village. In addition, we had already established some contacts among the people of Wassorola, so it was relatively easy to be accepted in the village for the interview.

### Data collection

Eight enumerators were hired and train in socio-economic data collection. We conducted the interviews in October 2010 and then carried out supplementary interviews in September 2011 to identify the species used as fuelwood by the rural community. After obtained demographic data, the respondents were asked about their awareness of the depletion of the forest around them and how surrounding vegetation has changed within their lifetime. There were three possible answers to the previous question: no change, depletion, and improvement of forest resources. The next question was about the reason for the change in the forest. Respondents were asked if they thought changes in their surrounding forest came about by natural causes which

meant that people cannot do anything about those changes, or if they thought that the changes were due to human activities (fuelwood exploitation). We wanted to know if the respondents intended to reduce their fuelwood consumption. To do so, respondents were asked what type of stove they have and what sources of energy they use for daily cooking. Respondents who use three stone-fire places were asked the two following questions: 1) Do you know if a three-stone fireplace consumes more fuelwood compared with other types of stove? and 2) Why don't you use an improved stove? Respondents were also asked about fuelwood acquisition, consumption and the time spent per day collecting fuelwood.

### Data analysis

Excel 2007 and R 2-15-2 were used to collate and analyse the interview data and crosstabs were made for ordinary and nominal data. Summary statistics of all numeric data were calculated. Principal component analyses (PCA) of the data were also calculated to understand the variation and structure of the data set. Seven variables were used in the PCA (Table1).

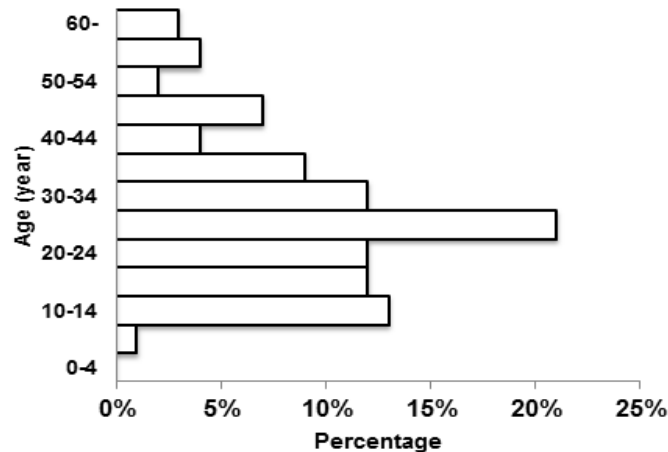
## RESULTS

### Respondent age distribution

The respondents were women only, because the men state that the women were more suitable to answer questions related to fuelwood. Figure1 shows respondent age distribution.

### Characteristics of the people of Wassorola

In Wassorola, there is an average of 6.45 adults per family with sample variance 34.57 and child is 6.2 children per family with sample variance 20.74.



**Figure 1:** Respondent's age pyramid. X axes: Percentage of respondents, Y axes: Age categories of the respondents.

The families of the respondents have very low income: the men cultivate the fields to obtain sufficient cereals to feed their families and the women are in charge of the household. In addition to their housekeeping activities, some women grow vegetables to gain extra income. Of respondents, 61% are housewives, 18% have a small garden, and the remaining 21% engage in other activities (selling peanuts, hand-made tools).

The survey shows the level of education of the women interviewed is low: 84% never attended school and do not know how to read or write in any language; 6% attended elementary school; 8% attended secondary school; and 2% attended high school.

Respondents were asked to evaluate the changes in the forest surrounding their village. The majority (83%) of the respondents recognize that the wetlands have dried up, and the forest area has shrunk within their lifetime. These 83% of respondents are aware of the depletion of the forest land. In light of this, respondents were asked to give a reason for these changes in the wetlands and forest. Most (68%) of the respondents answered that it is due to human action, while 12% thought it is due to natural causes and no one can prevent these changes from happening. The interviews shows that the respondents are not very involved in environment organization activities with only 9 respondents belonging to an environment community.

### Fuelwood usage

Respondents were asked how they get their fuelwood. 77% collect fuelwood, 17% buy fuelwood and the remaining 6% sometimes collect or buy their fuelwood. The survey reveals that 94% of fuelwood collectors are married women, and some of these women are helped by their sons or daughters to collect the fuelwood. Boys and girls (those under marriageable age, that is, under fifteen

years old) make up 4.8% of fuelwood collectors and men occupy 1.2%. Other studies show that women are the main fuelwood collectors (Madubansi, 2007).

Those who collect fuelwood were asked how often they collect it. The survey revealed that 72% of the families collect fuelwood daily, 14% once a week, 2% twice a week, and 12% once a month. Those families who collect fuelwood once a month have a donkeycart, so they use their cart to carry enough fuelwood for a month. Those who buy fuelwood spend on average 0.50 USD a day to buy fuelwood.

Species used as fuelwood by rural people are chosen based on their flame quality, how long it burns, whether it is smokeless, and most important, if it imparts a bad smell to cooked food (Clement, 2003). Table 2 shows the fuelwood species used in Wassorola according to the survey data.

Cooking frequency dictates the amount of fuelwood used. It is normal in Mali to cook three times a day. In Wassorola, 60% of family units cook three times a day and 36% cook twice a day; they cook breakfast and a substantial lunch to provide enough leftovers for dinner. The survey also shows that 4% of families accommodate food shortages by cooking only once a day.

Fuelwood collectors were asked about the amount of time they spend on fuelwood collection. The people of Wassorola do not measure exact time. In the interviews, they just answered with the likely time spent on fuelwood collection which was between one and four hours. All the fuelwood collectors stated that the time spent on fuelwood collection is longer than in the past due to the scarcity of fuelwood in close proximity (less than 1 km) to Wassorola.

Stove types play an important role in the quantity of fuelwood consumed. Efficient-stoves consume less fuelwood. A three-stone fireplace is not efficient, but 90% of respondents use one. Only 4% use a clay stove, and the remaining 6% use a three-stone fireplace and clay

**Table 2.** Species used as fuelwood in Wassorola.

Species	Rank
<i>Isobertia doka</i>	1st
<i>Detarium microcarpum</i>	2nd
<i>Pteleopsis suberosa</i>	3rd
<i>Hymenocardia acida</i>	4th
<i>Parinari polyandra</i>	5th
<i>Daniella oliveri</i>	5th
<i>Terminalia macroptera</i>	7th
<i>Uapaca somon</i>	8th
<i>Afromosia laxiflora</i>	9th
<i>Pterocarpus erinaceus</i>	10th
<i>Guiera senegalensis</i>	11th
<i>Nauclea latifolia</i>	12th
<i>Erythrina senegalensis</i>	12th
<i>Parkia biglobosa</i>	15th
<i>Ficus gna phalocarpa</i>	15th
<i>Vitellaria paradoxa</i>	15th
<i>Prosopis africana</i>	15th
<i>Combretum ghasalense</i>	15th
<i>Blighia sapida</i>	15th
<i>Combretum velutinum</i>	15th
<i>Acacia senegal</i>	15th
<i>Cassia sieberiana</i>	15th
<i>Crossopteryx febrifuga</i>	15th

Source (Survey of 2011). Species: Latin names of the species, Rank: order of species according to their preference as fuelwood by respondent

stove to cook. Using a clay stove instead of a three-stone fireplace saves 55 to 90% of fuelwood (UNEP, 1991). The villagers of Wassorola were asked to give a reason for not adopting a clay stove: 40% said that they do not know how to make one, 33% said they have no money, 9% said, they have no interest in clay stove, and the remaining did not answer. All respondents confirmed that they use mainly fuelwood. 99% use fuelwood and 1% use charcoal. Charcoal can be obtained if water is poured on the burnt fuelwood after cooking is finished. The interviewers noticed that the villagers let the remaining fuelwood burn. Respondents planted tree, 99% of the respondents have already planted tree, but unfortunately they plant them to get benefit of shade during summer, not to produce fuelwood.

### Principal component analysis

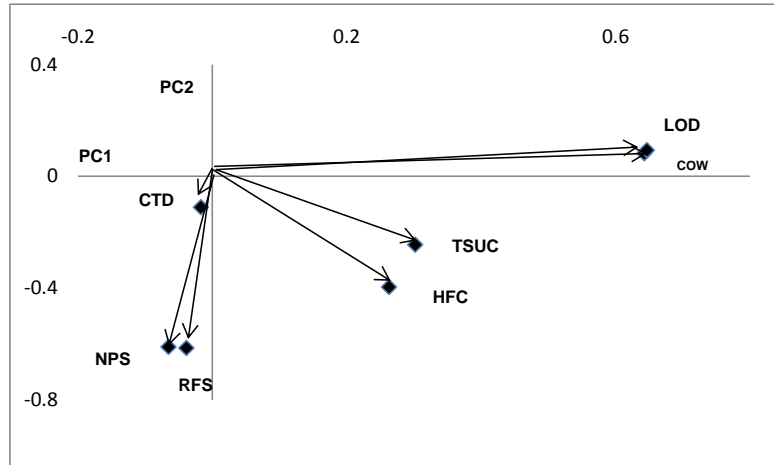
Principal component analysis (PCA) of 7 variables shows that PC1 explains 28.84% of variance, and cumulative portion of 76.67% variance is explained by PC1, PC2, PC3 and PC4. The variables of level of education and capacity to read and write have the highest absolute value of loading in PC1. This result suggests that these 2

variables varied together. The variables of number of people living as stakeholder, and reason for changes in the forests surrounding them have the highest value of loading in PC2. This result suggests that respondents with many family members tend to think that the reason for forest degradation is not due to human activities. PC4 shows that the variables of reason for forest changes and type of stove change together (Figure 2 and Table 3).

The plot of PC1 against PC2 shows that capacity to read and write (COW) and level of education (LOE) are closely correlate, which seems obvious because the more one is educated, the more one his able to read and write. Loading plot of PC1 against PC2 suggests that respondents in household with many people cook several times a day, and they tend to think that the reason for forest degradation is not due to human activities. It also suggests respondents who think forest resources are degrading tend to adopt clay stoves (Figure 2).

### DISCUSSION

The large number of adults and children living in a household can be explained by the fact that in rural areas of Mali, a man can live in his parents' house even after



**Figure 2.** Loading plot PC1 by PC2. LOE: Level of Education, COW: Capacity to read and write, TSUC: Type of Stove Used to Cook, HFC: How Forest has Changed, NPS: Number of People of Stakeholder, RFC: Reason for Forest Change, CTD: Cooking Times a Day.

**Table 3.** Principal component analysis of 7 variables relate to fuelwood.

Label of variables	PC1	PC2	PC3	PC4	PC5	PC6	PC7
Numb.of.People	-0.065	<b>-0.611</b>	0.235	-0.194	0.446	-0.572	0.00059
Read.write	<b>0.643</b>	-0.082	-0.159	-0.183	-0.154	0.0372	-0.703
Education.level	<b>0.647</b>	0.093	0.155	0.136	0.157	-0.033	-0.709
Cmt.frt.chge	0.263	-0.397	-0.279	0.0916	-0.754	-0.340	-0.0073
rsn.chgmt	-0.0383	<b>-0.615</b>	-0.0283	<b>0.523</b>	0.127	0.572	-0.020
Type.stove	0.302	-0.245	-0.330	<b>-0.750</b>	0.081	0.409	0.0262
cooking.time.a.day	-0.017	-0.111	<b>0.840</b>	-0.252	-0.398	0.241	0.0050

PC1 up to PC7: are different principal component, Num of People: Number of people living in household, Read write: Capacity to read and write, Education level: Education level of the respondents, Cmt frt chge: How have the forest resources changed, Rsn.chgmt: The main reason for the changes in the forest, Type stove: which type of stove do you use to cook? Cooking time a day: How many times a day do you cook?

marriage. That is a traditional way of living in rural Mali. As a result, it is quite common to see several couples living in the same house. Couples living together have the advantage that when they cook together meals are made in big pans, which reduces the amount of fuelwood used per capita compared with smaller family units. Results of another study showed that smaller households consume more fuelwood per capita compared to the larger households (Knight, 2012).

Twelve percent of the respondents think that forest changes in Wassorola are due to natural causes and no one can prevent these changes from happening; the people who believe this, need education to help them understand the real reasons, because changes in forest resources are not reversible. Such people cannot be educated by issuing handouts, books, and the like, because they cannot read or write at any language. Others studies showed that education is the most significant factors to make people understand the core reason of forest resources degradation (Jan, 2012).

The PCA results show that families with many people are likely to be among the above mentioned 12% who think that forest changes in Wassorola are due to natural causes. Such a position may be due to the influence of culture on perception. These families are very traditional in their outlook and to think that forest degradation is natural has its roots in tradition and legend in Mali. The influence of tradition on forest conservation in Africa was illustrated in a book by Anderson. He mentioned about the beliefs that forest degradation is due to nature (Anderson, 1987).

The high illiteracy level among adults is a direct consequence of the fact that Mali was under a military dictatorship (CAD-Mali, 2009), during which time education was low priority. During the period of dictatorship only 400,230 students in the whole country were enrolled in elementary school (Morcoux, 1995). Another reason for the low literacy in rural areas of Mali, is that children help their families with work which prevents them from attending school (Diakite, 1988).

Although respondents do not need to pay for clay stoves (the materials needed to make a clay stove are freely available in the village), 33% of the interviewees mentioned lack of money as a reason not to adopt a clay stove. We asked some environment project group, non-government organisation leaders and the chief of the government forest service why these people raise the issue of money for not adopting a clay stove. They answered that some previous projects issued iron stoves to women or sponsor families to have stoves (DNCN, 2001; SED, 2000), so these 33% want us to do the same. Distributing stoves to the Wassorola villagers would only be a short term solution because once the distributed stoves need replacing the situation would go back to square one. That is one of the controversies of social cash transfers (Samson, 2009). Provision of aid may sometimes create a dependency on aid. Some people may wait only for aid and lose the ability to solve their own problems (Riddell, 1987). The 33% of respondents who mentioned needing money to build a clay stove may be dependent on aid. To overcome this dependency one can use participatory rural appraisal (PRA) to build the capacity of citizen to be active in society. In communities, people have different capacities to understand problems faced by the community. They have different opinions on the scale of problems how to come to grips with problems, and what the potential solutions may be. Some can understand a problem quite well, while others have difficulty. PRA can play an important role in helping members of a community to overcome their differences and act together to tackle the issues in their community. It allows different groups to discuss problems and take inclusive decisions to solve them.

The biplot suggests that respondents from households with many people cook several times a day and tend to think that forest degradation is not due to human activities. It is easy to understand that a large number of people in one family would result in more frequent daily cooking, however it is difficult to determine why a larger number of people in a family would result in the tendency to think that forest degradation is not due to human actions. This situation could be explained by the fact that most large family units in rural Africa are those which have strong traditions and beliefs (Mikell, 1997). In Mali, there is a traditional belief that resources degradation is natural, so that may influence the opinion of respondents whose families have strong traditions (Large family units).

The more one is informed about an issue, the more one is willing to take action. That is confirmed by result of the biplot, which suggests respondents who think forest resources are degrading tend to adopt a clay stove.

## CONCLUSION

The results of this research tell policymakers that most villagers are aware of the depletion of forest resources, that they already know the reason for depletion is human

activities, and that they know clay stove conserve fuelwood compared with three stones fireplaces.

Policymakers should focus on how to get rural communities to adopt clay stoves, and any action should focus on women because they are the main fuelwood collectors.

This study illuminated the inefficient use of fuelwood by the people of Wassorola. Although they are aware that clay stoves save fuelwood, they continue to use three-stone fireplaces. Also the villagers do not take advantage of charcoal, (obtained by pouring water on burnt fuelwood at the end of cooking); unfortunately, they let the remaining fuelwood burn.

The villagers are aware of diminishing forest resources in Wassorola, but they do not act to stop, prevent or mitigate these changes. Future studies should focus on how to motivate villagers to take an active role in the protection of their forests, to educate villagers about the necessity of saving forests for current and future generations and to introduce fuelwood saving clay stoves to the Wassorola community.

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