

Analysis of Wood Needs in Rural Households in TA Chadza, Lilongwe District, Malawi



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List of abbreviations

APC:	Agricultural Project Committee
GVH:	Group Village Headman: Traditional chief responsible for a group of villages.
MK:	Malawian Kwacha (<u>exchange rate - 05/01/2017: 1\$ = 725 MK</u>).
TA:	Traditional Authority: Each district is divided in areas under the responsibility of a TA.
VH:	Village Headman: Traditional chief responsible for a single village.

1. Introduction

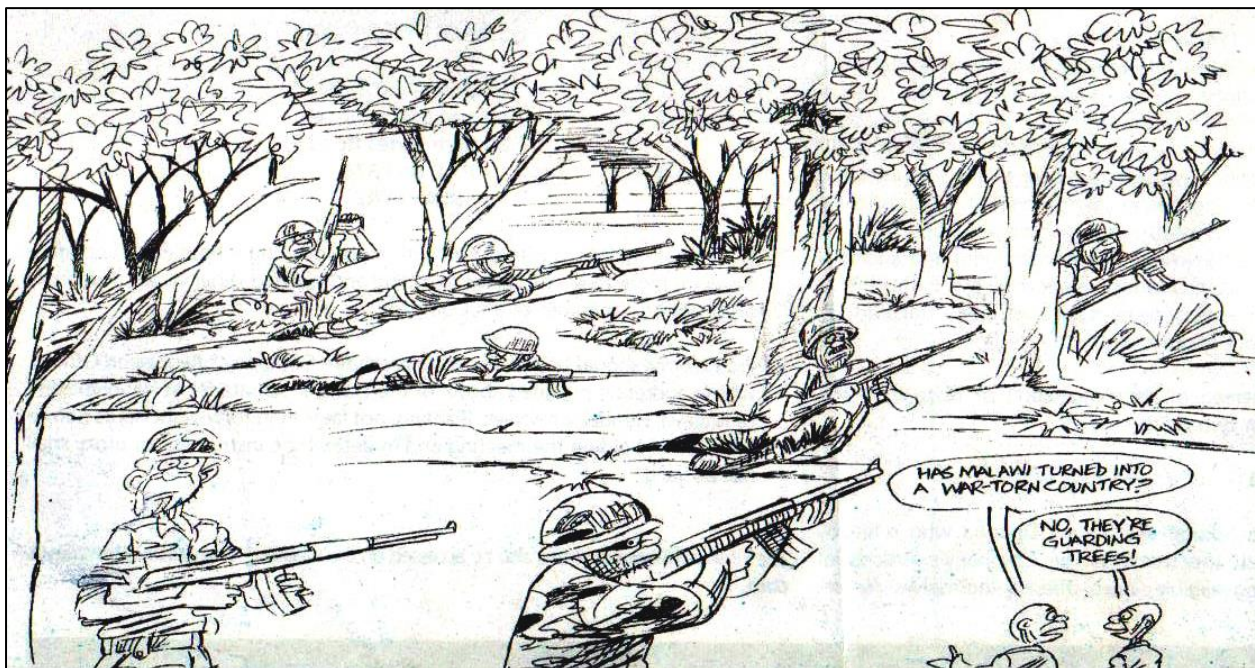
Malawi is currently facing a host of challenges, starting with its population growth which has reached 3,07% per year (World Bank, 2015a). 85% of its population relies on non-mechanized small-scale agriculture (Sosola et al., 2010) and 84% of Malawians live in rural areas (World Bank, 2015b). To address their energy needs, rural households mainly use wood, which has led to an intensified pressure on wooded areas. Despite the establishment of restrictive (and repressive) measures, the government has not succeeded in containing this phenomenon. The deforestation rate between 1972 and 1993 has reached about 2.8% per year (Kainja, 2000).

Table 1 - Deforestation between 1972 and 1993 for both indigenous and plantation forests of Malawi. Kainja (2000)

REGION	1972 FOREST EXTENT (Ha)	1992 FOREST EXTENT (Ha)	TOTAL FOREST LOST (Ha)	RATE OF DEFORESTATION (Ha/YEAR)
NORTH	1,507,266	470,238	1,037,028	51,851 (3.4 %)
CENTRAL	1,488,110	777,217	710,893	35,545 (2.4 %)
SOUTH	1,404,510	650,860	753,650	37,683 (2.7 %)
TOTAL	4,399,886	1,898,315	2,501,571	125,043 (2.8 %)

This uncontrolled deforestation has led to an increasing scarcity of wood and the population is now forced to buy wood or travel further and further to collect it. By mobilizing workforce, wood supply does not only compete with agricultural work but is also a significant cost item.

This study aims at better understanding the wood needs and supply strategies of the rural farming families. The main findings of this study are presented in the present document. Other documents come back on technical solutions that have been developed by certain farmers.



2. Use of wood in rural areas

a. Fuelwood for cooking and heating

In Malawi, wood is the first source of domestic energy. 96,1% of the population of the Lilongwe District (where the study area is situated) uses wood daily for cooking (figure 1). Far behind wood use is charcoal use (1,4%), which confirms that the large majority of the population's energy needs are satisfied by wooden resources¹.

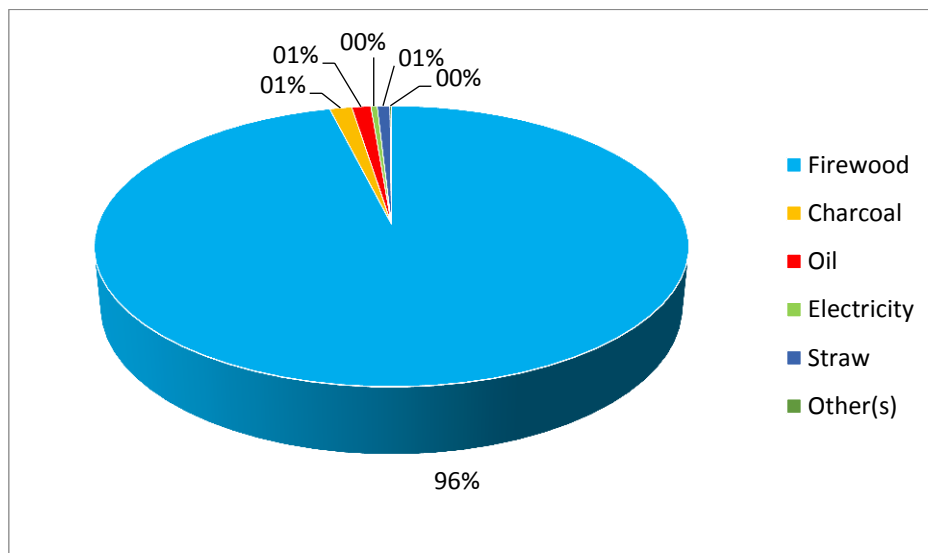


Figure 1 - Repartition of energy sources used by households for cooking in the Lilongwe District.
Source : Republic of Malawi (2011)

These results are corroborated by the surveys conducted in sixty two villages of TA Chadza. The results from these interviews and focus groups confirm that the totality of rural households² use wood for cooking and, usually from the same fire, for heating bath water for all family members, year-round.

Women, in charge of meal preparation, cook with a traditional stove called « mafoua » in chichewa. This simple system is made up of three stones or bricks arranged in a triangle. The pot lies on top and wood pieces are crossed together in the middle (figure 2).



Figure 2- Traditional stove called "mafoua". Abadia (2016)

¹ Excluding crop residues.

² « Rural households » here indicates households who live in remote villages, unconnected to the electricity network. Therefore, the results of this study are not applicable to the context of trading centres as Nathenje, where households have access to electricity.

According to our surveys³, on average, women prepare **3.25 hot meals⁴ per day during the dry season and 2.06 during the rainy season**. Maize flour is the staple food, cooked as porridge for breakfast and used for the preparation of “nsima”⁵, consumed for lunch and dinner. The cooker stove is also used to heat bath water (following the preparation of the meal) and sometimes for brewing local beer.

Table 2 - Composition of daily meals. Abadia (2016)

Meal	Dry season	Rainy season
Breakfast	Porridge	
Lunch	Nsima	Nsima
Dinner	Nsima	Nsima
Snack	Sweet potatoes, cassava, papaya	Cassava

b. Construction

- ✓ **Bricks production:** in Malawi, houses are traditionally built from bricks, made in villages and dried in the sun, making their production cost very low. Nevertheless, the lifespan of a brick house is short (about 5 to 7 years according to our surveys) and it needs to be regularly repaired.

To overcome these constraints, there exists a cooking process for bricks which allows the houses' lifespan to be extended by 5 to 10 years. This process is costly because it requires a big amount of wood to supply the oven. Therefore, cooked bricks are too expensive for a majority of rural households, which are forced to use uncooked bricks and to frequently rebuild houses.

According to surveys⁶, the construction of a medium-sized house requires **8 000 bricks** (for a five-member household) and their cooking requires **8 to 10 full-grown trees**, for an amount of **17 500 MK ~ 22 euros** (excluding transport costs).



Figure 3 – Oven for bricks and firewood. Abadia (2016)

³ 19 interviews conducted with women from two villages of TA Chadza.

⁴ The usual hot meal consists in a plate of nsima per person, accompanied by a sauce made of vegetables, eggs and occasionally fish or meat.

⁵ Nsima: dish made of maize flour cooked in water which constitutes the staple food in Malawi and in many Eastern African countries. It is served with a sauce.

⁶ 11 interviews on wood needs and inherent costs linked to the building of a house.

✓ **Frame construction:** wood is also used for frame construction. When the roof is made of grass, the frame is constructed with light branches (species: *Senna spectabilis*, *Bambuseae* sp.). Bamboo has the advantage of being easily available everywhere and is therefore cheap. Nevertheless, it is not termite-resistant and it is sometimes necessary to rebuild the frame after only one or two years.

On the other hand, wood from *Senna spectabilis* is termite-resistant.

For metal-sheet roofs, the frame is generally made with larger "raw" wood (species: *Senna spectabilis*, *Eucalyptus* sp.). Even if this is rare, some well-to-do households buy cut frames made by carpenters.

According to our surveys, for a medium-sized house built with 8,000 bricks, the cost for the frame is about **20,000 MK ~ 25 euros** (transport cost included) and requires branches from **7 to 10 trees**.

Doors and windows are bought from carpenters in trading centres. People do not use their own trees to build them.



Figure 4 - *Eucalyptus* sp. Stems for frame. Abadia (2016)

✓ **Agricultural material and tools:** wood is also used to build agricultural material (maize granaries, tobacco barns) and tools. Expenses vary from one household to another and generally increase with the standard of living. Poor households do not cultivate tobacco and their maize harvests, being insufficient to be stored in granaries, are stocked directly inside houses. Carts are bought in Lilongwe and are not locally made.



Figure 5 – Maize granary. Abadia (2016)



Figure 6 – Tobacco barn. Abadia (2016)

It is difficult to estimate timber needs because they are occasional and depend on several factors: availability of materials that can replace timber, needed quantity, pole size, resistance to termites, lifespan of the building, etc. In all cases, use and purchase of timber by rural households are occasional.

*Interviewee n°1: M. Mjanji used 10,000 bricks to build his house. To cook them, he bought 7 carts of wood for an amount of 16,900 MK (12,000 MK of wood + 4,900 MK transport costs). Then, he spent 20,000 MK to buy a frame because he installed a metal-sheet roof. The transport cost for timber was 7,500 MK. Therefore, he spent a total amount of **44,000 MK ~ 55 euros** to buy and transport wood in order to build his house.*

*Interviewee n°2: M. Chinkinda cooked 6,000 bricks to build his house. He bought 11,500 MK of wood to cook them and 21,600 MK for the frame (transport cost included). The roof is made with iron sheets. In total, he spent **33,100 MK ~ 41 euros** for the transport and the purchase of wood.*



Figure 7 – House with a grass roof. Abadia (2016)



Figure 8 – Iron sheet roof. Abadia (2016)

3. Crop residues, an alternative to firewood

a. Different types of residues

✓ **Maize stalks:** Dried maize stalks are used as fuel from the beginning of the harvest (April – May) until September – early October, when it is time to clean fields and prepare the next cropping season. Women and children are in charge of harvesting maize stalks. This collection is completely free, meaning villagers can collect maize stalks from all fields, without any private property distinction. They usually start to collect them in plots located near the village and draw away as the dry season progresses. Between April and beginning of October, housewives need one hour per day to collect maize stalks. It is a constraining task as all leaves must be removed from the stalks before they are brought home.

According to surveys, every housewife spends one hour per day completing this task between April and beginning of October, which represents 4 to 5 man-days per month. Crop residues represent up to 50% of fuel used during the dry season.

After the harvest of cassava, farmers who grow maize also use the stalks to build fences around their field as they need to be rebuilt every year.

Despite an initial hypothesis that the use of maize stalks for fuel leads to a competition with soil fertility measures, it appears that this is not completely true. While some farmers do bury maize stalks in the soil between ridges in order to renew fertility, it is not a common practice. There are several factors that explain this strategy, starting with the lack of workforce. If farmers want to bury maize stalks they have to do it in May – June, because stalks require time to be degraded by micro-organisms before the next cropping season. However, this period corresponds to the period of post-harvest work (husking, milling) and to the harvest of groundnuts and soya. Most households experience a workforce deficit in this period and therefore allocate it in priority to harvests.

Moreover, farmers bury maize stalks in their plot if, and only if they are planning to sow maize again in that field. If they are going to sow groundnut, they will not bury them because groundnut is a leguminous plant, which fixes its own nitrogen and does not need to be enriched. They save workforce by burning stalks in the field rather than burying them. Finally, some households never bury stalks because they are afraid that they will attract insects, which then will attack the seeds they have sown.

The majority of households compromise between fertilization and energy, by burying small stalks and keeping bigger ones as fuel.



Figure 9 – Dried maize stalks. Abadia (2016)

✓ **Maize cobs:** they are used from the beginning of husking (April – May) until maize stocks are finished. Most households do not have cobs anymore starting from October – November. However, those who have granaries can keep them during the rainy season.

Well-to-do families also swap maize cobs for workforce. Farmers will invite other families to husk their maize and each participant can keep the cobs s/he has husked. Some cobs are kept for the rainy season. Maize cobs are only used as fuel, they do not have any other utility within the farm. They have been used since Malawians started to cultivate maize as they have always been brought back to the house to be husked.



Figure 10 – Maize cobs. Abadia (2016)

✓ **Cassava stems:** the cassava harvest starts in June and continues until November – December. Farmers keep stems during the harvest and they generally store them for the rainy season. Unlike maize stalks, the harvest of cassava stems is not available to everyone but rather only to the farmer harvesting that plot.



Figure 11 – Dried cassava stems. Abadia (2016)

✓ **Tobacco stems:** tobacco growers use stems starting from the harvest, which occurs in March – April, until field cleaning time (August - September). If the owner decides to leave stems in the field and does not use them, other households can take them if they ask for permission. According to Jumbe et al. (1997), the combustion of tobacco stems releases a harmful smoke, particularly dangerous for children, due to its high content in toxic and carcinogenic agents.

b. Use of crop residues: an indicator of wood scarcity

During the first years following the independence of Malawi (1964), the government supported the plantation trees on two levels: by establishing forestry plantation in order to ensure self-sufficiency of Malawi in terms of timber, and by creating the “National Tree Planting Programme”, a programme based on the promotion of speed-growth exotic species in rural areas (Mauambeta et al., 2010). The government of Kamuzu Banda kept a close watch on cutting activities because the selling of wood from plantations was a significant source of income for the State. Rural populations could collect firewood in common woodlots (hills, bush) and during the opening of new croplands (slash-and-burn). During this period, people did not use crop residues as fuel, apart from maize cobs and tobacco stems because they were already brought back to the home after the harvest.

In 1994, Muluzi succeeded Kamuzu Banda and replaced his twenty-seven years' dictatorship by a multi-party democracy. This transition led to the return of individual rights but at the same time, it had a perverse effect on natural resources. For Malawians, the end of the authoritarian regime signified the beginning of a new era giving free access to forestry resources. The sudden transition from the dictatorship to the democracy led to the destruction of Kamuzu Banda's tree plantations and an acceleration of deforestation (Mauambeta et al., op. cit.). The “National Tree Planting Programme” and linked subsidies were also stopped.

In addition to this, the high population growth rate caused an increase in fuel needs. The government has not succeeded in assisting this rise and nowadays, Malawi is still in a significant energy crisis. Infrastructures, especially for electricity supply, are insufficient to satisfy the needs of an increasing population. The latter has no other choice than to use wood, even as this resource is more and more scarce and expensive. Therefore, crop residues are an alternative for poor rural households which are not able to satisfy their wood needs.

Nevertheless, the use of crop residues is a constraint. For women, cooking with residues is a heavy chore because it produces a lot of smoke. Moreover, residues burn very quickly so they require constant attention and women cannot do several chores at the same time. Finally, collection of crop residues is a long daily work (2.1.1.). Therefore, the use of residues is time-consuming and harmful for health (Bunderson et al., 2008; Jumbe et al., 2006).

Households come to terms with these constraints because residues are a significant source of fuel during the dry season. According to Fisher et al. (2002), crop residues are the main source of energy for some households who live in the southern region of Malawi.

According to surveys, thanks to the use of crop residues, rural households can divide by two the quantity of wood that they use during the dry season. Crop residues satisfy 20 - 25% of their annual energy needs for cooking and heating. These results are slightly higher than the ones that Kamoto (2014) obtained in Balaka (table 3).

Table 3 – Proportion of crop residues among households' energy sources in Balaka, Malawi. Source: Kamoto (2014)

% of crop residues among the total energy used	Number of interviewees
1 – 10%	13
11 – 20%	9
21 – 30%	3
Total	25

c. Other alternatives to firewood

✓ **Charcoal:** some families occasionally use charcoal during the rainy season but its price is high (5000 – 7000 MK/bag ~ 6.5 to 8.5 euros) and prohibitive for most rural households. The charcoal comes from the Dzalanyama Forest and its production is illegal.

✓ **Other sources:** like crop residues, wooden parts of some plants are occasionally used as fuel. Bamboo, *Tithonia diversifolia* and sisal (*Agave sisalana*) are used in this way.

Remark: Households do not use animal dung as fuel, as it is kept for cropland fertilisation.

4. Seasonality and use of different types of fuel

a. Calendar of the usage of different type of fuel

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
	Rainy season				Dry season							Rainy S.
Charcoal	Red				White							Red
Maize stalks	White			Purple							White	
Maize cobs	White			Orange							White	
Cassava stems	Green	White			Green							
Tobacco stems	White		Cyan							White		
Firewood	Pink											

Figure 12 – Calendar representing the usage of different type of fuel. Abadia (2016)

During the dry season: according to surveys, households use crop residues even if they have private trees. Households who have enough trees also use residues in order to sell wood or to save it for the rainy season or other uses (construction). Moreover, crop residues are available near the village and they are useful to light a fire. Furthermore, some poor households only use crop residues (and no wood) during the dry season.

During the rainy season: during the main part of the rainy season, households do not have crop residues to burn anymore. Even if some of them store cassava stems and maize cobs, these are not enough to satisfy their needs during all of the rainy season.

Charcoal is expensive so it is never exclusively used. Therefore, households have two options: using their own trees or buying firewood.

b. Use of private trees

For firewood supply, private trees are mainly used during the rainy season. At the end of the dry season, farmers start to chop down branches or entire trees in anticipation of the rainy season. They transport firewood to their home the same day or the day after, because there are cases of theft when they leave wood at the foot of the tree.

Households avoid chopping down trees only for firewood. They prefer to keep them alive and most of the time, they only chop down branches by using different pruning techniques (pollarding, coppicing, side pruning).

c. Purchase of standing trees

Sometimes, households who need firewood during the rainy season buy one or several standing trees. The trees are bought at the end of the dry season in order to let them dry in the sun before the rains start. Prices are negotiated according to species and size. A medium-sized tree costs between 1,000 and 3,000 MK ~ 1.25 to 3.75 euros.

Financially, it is more beneficial to buy a standing tree and to chop it down than to buy dry wood (cf. section 5). Nevertheless, this implies constraints which can be difficult for households to overcome. First, workforce is needed to chop down and divide the tree. Then, the wood needs to be transported to the home when it is chopped or on the next day to avoid theft. If the tree is far from the village and the farmer does not own a cart or bicycle, he must rent one for 1,000 MK/trip (1.25 euro). This work has to be done at the end of the dry season, which corresponds to the field preparation time for maize because it is more difficult to dry wood during the rainy season. Finally, liquid assets are needed (1,500 to 2,000 MK ~ 1.8 to 2.5 euros) to buy the tree whereas when dry wood is bought, expenses can be spread over several weeks.

Remark: Only few households have enough trees to regularly sell wood. Most of the time, tree selling is occasional, in response to an immediate need for money.

d. Purchase of dry wood

Households buy dry wood in their village, either from other inhabitants or from sellers who chop it in the Dzalanyama forest. Firewood is sold in bundles (two or four pieces) and its price varies depending on the season and the demand (cf. section 6). Farmers who sell firewood as a business activity are still rare but this activity is profitable and should develop in following years.

5. Estimation of rural households' wood needs

According to surveys, a medium-sized family (two adults and three children) needs between **1,900 and 2,250 kg of firewood per year to cook** (630 – 750kg/person/year). This estimation takes into account the use of crop residues to satisfy 50% of fuel needs during the dry season. During the second part of the dry season and the totality of the rainy season, the family is considered to be using only firewood. **If the family do not use crop residues, its annual consumption should reach between 2,500 kg and 3,000 kg of firewood (only for cooking).**

Table 4 - Estimation of annual wood needs for a rural household. Abadia (2016)

	Dry season	Rainy season
Number of warm daily meals	3,25	2,06
Daily quantity with crop residues (kg)	4,68	6,5
Daily quantity without crop residues (kg)	9,35	6,5
Total per season	475 – 563 kg + crop residues	950 – 1125 kg
Annual total with residues (kg)	1 900 à 2 250	
Annual total without residues (kg)	2 500 à 3 000	

According to Jumbe et al. (op. cit.), a Malawian household (5.4 members) consumes about 4,545 kg of firewood per year. Fleuret et al. (1978) indicates that a Tanzanian household (5 members) consumes 8,180 kg of firewood per year whereas a three-member household needs 7,634 kg/year.

The data we obtained by weighing firewood is below values extracted from the bibliography. Those studies were carried out many years ago, in other African contexts where wood resources were probably available in larger quantities than in our study area. Another study, carried out by the Malawian Government (Government of Malawi; op. cit.), shows that rural households in Central District annually consume 646 kg of wood per capita, which is in tune with our values.

6. Firewood market

a. The Dzalanyama forest, the main reserve of firewood in the Lilongwe District

Dzalanyama is a protected forest of 989,300 Ha (Government of the Republic of Malawi, 2011), 619,199 of which are located in the Lilongwe District. Regarded as the “water reserve” of the capital city, the Dzalanyama forest is in danger due to illegal charcoal production activities.

In order to solve deforestation issues, the government has deployed the army around the forest but this measure has proved insufficient to ensure its preservation. According to Munthali et al. (2013) “out of the approximately 100,000 people that depend on charcoal for their livelihoods, slightly over half are involved in the actual production.” Even if we consider these results to be overestimated, they show the socio-economic concerns linked with the Dzalanyama forest. Despite the repressive measures implemented by the government, charcoal producers still go illegally into the forest.

At the same time, the wood extracted from Dzalanyama is legally exploited. The supply chain is well organised and ensures the firewood supply of households living in Lilongwe and in surrounding trading centres. Sellers must pay a 200 MK entrance fee to enter in the forest, where they are allowed to collect dry wood. They load it on their bicycles and sell it in urban areas.



Figure 13 – Dzalanyama Forest. Abadia (2016)

b. Traditional rules about the exploitation of common forestry resources

In all villages in the area, it is completely forbidden to chop down wood in forests around graveyards. Villagers can only collect firewood from these forests for funerals after obtaining the chief's consent (the firewood is then used to cook for the guests). The chopping in common areas is also controlled by Village Headmen (VH) and Group Villages Headmen (GVH). In some villages, villagers are allowed to collect dry wood and to cut branches in uncultivated spaces and on hills if the chief agrees. In other areas, this is totally forbidden by the traditional authority. Some villages have a common woodlot managed by the community (GVH Makhanga, GVH Chidambayla, GVH Mbangom'be). In this case, rules vary from one chief to another one but they are always very restrictive. In our study area, common areas cannot be considered as a main source of firewood, except for funerals and religious ceremonies.

c. Firewood sector

The firewood sector is organised in two sub-sectors:

- The "firewood from Dzalanyama" sector
- The "firewood from villages" sector

As explained before., commercial production of firewood is rare in the study area, except for a few farmers. Sellers who go to Dzalanyama are the only ones who make a living thanks to firewood trading. The "firewood from Dzalanyama" sub-sector is well-organised but the production and selling inside villages are more disorganized.

✓ **The "firewood from Dzalanyama" sector**: sellers practice door-to-door selling or sell on local markets in Lilongwe. Sometimes, they stop in villages on their way to Lilongwe to sell a part of their load. When they sell this firewood, it is already dry and cut in small pieces. Selling prices are higher in towns than in villages but some sellers apply the same prices when the demand is high. Prices are relatively stable in the medium term and not much negotiable.

✓ **The "firewood from villages" sector**: households cut and sell wood according to their needs and as of now, it is not a true income-generating activity. Firewood is often sold due to an immediate need for money. Trees represent a kind of saving which can be mobilized easily.

Some farmers generate profit by sustainably exploiting their trees. They use pruning techniques and they regularly plant trees to renew their reserve. Few acts this way as there is a lack of knowledge about pruning techniques and a lack of information about the potential economic profit of wood production.

*Interviewee 1: By pruning and selling branches from his ten years old *Senna spectabilis*, M. Pustani earns 600 MK/tree/year. He uses the pollarding technique to prune his trees which allows him to do so every year. With 24 trees, he earns an average of 14,000MK/year ~ 17,5 euros.*

*Interviewee 2: This man uses the coppicing technique, which consists in cutting the tree at the bottom, approximately 50cm above the ground, in order to stimulate the growth of new shoots. This technique works well with *Senna spectabilis*. He prunes his 46 trees every two years and earns 1,000 MK/tree ~ 1,25 euros, or 23,000 MK per year ~ 29 euros.*

The marketing of this small-scale production is random. Customers know of wood sellers by word-of-mouth and they negotiate the price on a case-by-case basis according to the size of the wood pieces. If the seller has an immediate need for money, the customer will be able to easily decrease the price.

Sometimes, elder people, widows or households who have a lack of workforce sell standing trees to avoid the labour of cutting. The wood is green so it is sold at a cheaper price than wood coming from the Dzalanyama forest. Its price will be higher if it is exploitable for timber. A *Senna spectabilis* reserved for firewood has an average price of **1,000 to 2,500 MK ~ 1,25 to 3,2 euros**. The transport cost can reach 1,000 MK per trip if the customer needs to rent a cart (depending on the distance).

d. Seasonality of wood prices

During the rainy season, the price of firewood increases because the demand is high. Dry wood is scarcer and there are no crop residues to burn.

According to surveys, prices vary with the size and the appearance of pieces but not according to the species. Prices also evolve depending on the origin of wood. Wood from the Dzalanyama forest is generally more expensive than wood from villages because it is firstly intended for urban households.

	Wood from villages (1 bundle of 4 pieces)	Wood from Dzalanyama (1 bundle of 4 pieces)
Dry season	50	100
Rainy season	100	300

Figure 14 – Price of dry wood according to its origin and the season 1 euro = 800 MK. Abadia (2016)

e. Estimation and comparison of supply costs

According to surveys, a household of 5 people needs between 1,900 to 2,250 kg of wood per year. Cutting and weighing a 3 years old *Senna spectabilis* (value: 1,500 MK) has shown that the tree provides 55.7 kg of dry wood.

That means a household should cut or buy **34 to 41 of this kind of tree** (*Senna spectabilis*) **in order to satisfy its firewood needs, or a total amount of 50,000 MK to 62,000 MK ~ 63 to 77,5 euros** (4,200 to 5,200 MK/month ~ 5,25 to 6,5 euros/month).

The poorest families earn around 165,000 MK/year ~ 206 euros, and medium families earn around 368,000 MK/year ~ 460 euros (Wittevrongel-de Comte, 2016). **Therefore, wood purchase corresponds to 10 to 22% of the poorest families' total budget.**

If the family buys the same quantity of wood from Dzalanyama, it will spend 300 MK/day during the rainy season or 150 MK/day during the dry season, meaning **81,000 MK per year ~ 101 euros** (6,750 MK/month).

By analysing these results, it is easy to understand why households use crop residues during the dry season and keep their trees for the rainy season. This allows them to minimise their purchase of wood. Families spend on average **2,000 MK/month ~ 2,5 euros during the dry season and 4,000 MK/month ~ 5 euros during the rainy season** (3,000 MK/month on average for the entire year). This data is consistent with that presented by Byers (op. cit.) according to which households of Maligunde EPA spend around 2,600 MK/month ~ 3,25 euros to buy food and first-necessity products versus 2,900 for firewood ~ 3,6 euros.

Even if they use crop residues, the majority of households are not able to satisfy their needs for fuel and are in a chronic situation of energy precarity.

7. Conclusion

Rural households in TA Chadza have substantial wood needs because for the majority of them, it is their only energy source with crop residues. Wood is also an essential building material for houses and agricultural material.

In the past, wood was present in quantity in Malawi but nowadays, lots of organisations such as NGOs and institutions are worried about the deforestation rate. Villagers are also uneasy because they are the first ones to be impacted by this phenomenon. They have more and more difficulties in finding wood and the working constraints linked with wood and residues' collection are higher than before. Prices are increasing as a consequence of the demand growth and the resource scarcity.

The use of crop residues is an alternative for households who are not able to satisfy their growing wood needs, however this is not a sustainable option. This practice gives rise to new questions about its impact on fertility and soil structure, in a context where there is already a fertility crisis (Kaczan et al., 2013). It also sets off new questions about the risks of burning crop residues and particularly their effect on the health of housewives (Jumbe et al., op. cit.).

This is a delicate issue and there is an urgent need for solutions to help households, and in particular for ways to reduce the use of crop residues and to reduce costs linked to wood purchase. We have already identified relevant ideas with the aim of improving households' wood supply. Tree plantation should be encouraged and assisted in order to ensure a high reforestation rate, with the aim of giving access to households to self-sufficient wood and to constitute new wood reserves in anticipation of demographic growth. According to farmers who have already adopted them, pruning techniques are also very relevant for improving wood supply in the long term and as an income-generating activity.

For now, local population does not consider trees as a cash crop despite them being a good source of income. By promoting tree plantation, we should also insist on economic aspects to show people the potential profit of wood production.

Finally, it is important to promote several tree species. As we have seen in this study, farmers use trees for different purposes (light firewood for cooking, firewood for brick oven, timber...). Each species has particularities and properties renowned for a particular use and it would be difficult to replace them. Therefore, improving wood supply also means diversifying species in order to satisfy all types of needs.

The question of biodiversity preservation is crucial in this area, where global warming is already perceptible (Kaczan et al., 2013). Reforestation is a unique opportunity to restore indigenous species' stocks in order to limit the weakening of ecosystems.

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