

## Contribution of Sale of Firewood Towards Rural Livelihood in Swaziland, and its Environmental Sustainability

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**Abstract:** A study was conducted along the Main Road number 3 (MR 3) to determine the contribution of sale of firewood to the livelihood of the rural population in the lowveld of Swaziland and its environmental impact. The study used structured questionnaires and interview schedules to collect data. The questionnaires were administered to 18 firewood sellers along the road who were selected systematically by administering it to every second firewood seller out of the total of 37 firewood sellers. The area under forest/woodlands was determined by analysis of Landsat Thematic Mapper (Landsat TM) and Landsat Enhanced Thematic Mapper (Landsat ETM) for 1994 and 2006, respectively. The results revealed that the majority of firewood harvesters had permission to do so from the owners and management of land where harvesting was taking place. The harvesting was not monitored, and there were instances of protected plant species being harvested for firewood. The amount of firewood harvested by each individual was not regulated. The sale of firewood contributed between US\$ 67 and US\$ 133 per month to the livelihood of the sellers. The contribution to the livelihood of the sellers was significant considering that 69% of the population in Swaziland live below the poverty line of US\$2 per day.

**Key words:** Environmental sustainability, firewood, livelihood, lowveld, poverty

### INTRODUCTION

**Background information for country:** The Kingdom of Swaziland covers an area of 17364 Km<sup>2</sup> and lies between latitudes 26° S and 27° S and longitudes 31° E and 33° E. It is surrounded on the north, west, and southern sides by the Republic of South Africa and on the east by Mozambique (Fig. 1). The two cities in the country are Mbabane and Manzini, with Mbabane being the capital city. The total population according to the 2007 census was 1018449 of which 537021 (57%) were females, while 440,154 (47%) About 77% of the population lived in the rural areas, with 23% in urban areas (Government of Swaziland, 2007). About 30% of the population faced food shortages in 2005/2006, and relied on donated food. It is estimated that about 40% of the population were facing acute food and water shortage in 2007 after the worst harvest in the country's recorded history (IRIN, 2007).

**Use of firewood and livelihood:** About two billion people use firewood and charcoal as their main source of energy for cooking and heating their homes in the world (CIFOR, 2009). It is estimated that 80% of the Swazi population lives on communal Swazi Nation Land (communal land) and use fuel wood for cooking and

heating. Rural households in developing countries, including Swaziland collect food, firewood, medicinal plants and construction materials directly from the forest. The factors that condition a household's economic reliance of forest resources vary depending on the resource endowment of the household, the household's demographic and economic characteristics and other factors such as markets, prices and technologies (Babulo *et al.*, 2008). Forest resources represent a common heritage and tend to be shared by a great majority of people (Nkem *et al.*, 2007).

People have realized a business in firewood selling. When driving along the major roads of the country especially those of the lowveld, one is welcomed by piles of firewood on the roadside. The firewood is sold mainly to motorists driving along these roads. Because of the high rate of unemployment many people are joining the firewood selling as a source of income. These leads to an increase in the demand of firewood from the forest and people end up cutting standing trees that are not dry and deforestation is encouraged. Swaziland has a total land area of 1736400 ha with 624000 ha being forest. Out of this, there are 463498 ha of indigenous forest and woodlands (FAO, 2007). About 201500 ha are under commercial forest plantation with another 25,000 ha under wattle forest.



Fig. 1: Map of Swaziland showing location of study area and major towns

The Swaziland Energy Balance of 1995 indicated that 26% of the total energy consumed was derived directly from firewood. Of this, about 90% was consumed by households (Government of Swaziland, 2000a). As the firewood and other non-commercial sources of energy become scarcer as a result of deforestation, the demand on liquid fuels and electricity would increase (Chartteji, 1981). Wood is a renewable energy source in the sense that a tree cut for fuel will naturally be replaced by a young tree that springs up in its place (Natural Resources Canada, 2007).

**Legislation on collection and sale of firewood:** The Forest Preservation Act of 1907 makes provision of the preservation of trees and forests growing on government land, and on Swazi Nation Land. It prohibits the cutting down, damage, removal, selling or purchase of indigenous or government timber without the permission of the Minister responsible for forest (Government of Swaziland, 1907). The Act does not prevent persons living on Swazi Nation Land from cutting brushwood or taking decayed or dead wood on such areas for use as fuel. The penalty for contravening the Act is a fine not exceeding one hundred Emalangeni (US\$ 13), or in default of payment imprisonment for a period not exceeding twelve months or both fine and imprisonment (Government of Swaziland, 1907). On the other hand the Private Forests Act of 1951 provides the regulation and protection of private forests. It states that it is an offence for any person who, without the authority of the owner or his agent cuts, injures, destroys, collects, takes or removes any tree, timber or other forest produce. Any person who

contravenes the Act is liable on conviction to a fine not exceeding two hundred Emalangeni (US\$ 27) or imprisonment for a period not exceeding one year or to both such fine and imprisonment (Government of Swaziland, 1951).

The Flora Protection Act of 2001 prohibits any person from picking, plucking, gathering and cutting protected flora. However the protected flora can be legally removed if it is on land that is genuinely required for agriculture, building or other developments after obtaining permission from the Minister responsible for flora (Government of Swaziland, 2001). The act does not constrain Swazi rural dwellers from collecting and processing plants outside flora reserves for their personal and domestic use, and not for sale or delivery to any other person (Government of Swaziland, 2001). The protected flora in the Act is categorized into three schedules. Schedule A contains especially protected flora (endangered), schedule B and schedule C contains vulnerable flora and rare flora respectively. Any person who cuts, picks, plucks or gather flora categorized under schedule A is liable to a fine of not more than two thousand five hundred Emalangeni (US\$ 330) or a term of imprisonment of not more than two years, while on the other hand any person who cuts, picks, plucks or gather protected flora under schedule B or C is liable to a fine not exceeding one thousand Emalangeni (US\$ 130), or a prison term of not more than one year. The trees that fall under category A include *Pterocarpus angolensis* and *Euphorbia clavigera*, while those that fall under category B include *Acacia xanthophloea*, *Albizia anthelmintica*, *Breonardia microcephala*, *Olea europaea* and

*Spirostachys africana*. Trees that fall under category C include *Trichilia ematica*, *Oleandra distenta* and *Dombeya rotundifolia* (Government of Swaziland, 2001).

**Sustainable use of forest resources:** For sustainable use of wood the site must be maintained with a variety of tree species of various ages and the harvesting practices must select only those trees that can be removed without damaging the forest ecosystem (Natural Resources Canada, 2007). In a study undertaken by the New South Wales (NSW) Scientific Committee it was found that accelerated and ongoing removal of standing dead trees and woody debris on the ground caused by human activity was a factor contributing to loss of biological diversity (NSW Scientific Committee, 2007). Examples of the process included illegal or poorly regulated firewood collection from forests or woodlands. From an environmental point of view managed forests provide climate change mitigation benefits over time through sequestering carbon, and thus reducing the amount of carbon dioxide released in the atmosphere (Ruddell *et al.*, 2007). As an example of the benefits of managed forests on control of greenhouse gases, Swaziland reported to be a net sink of greenhouse gases in 1994 because of the uptake of carbon dioxide by the managed forest plantations in the country (Government of Swaziland 2000b). Integrated natural resources management, including the management of forest resources can play a vital role in rural development, from both agricultural and environmental perspective (Twomlow *et al.*, 2008).

The objective of the study was to determine the contribution of sale of firewood to livelihood in the lowveld of Swaziland, and to determine the environmental impact of this small scale firewood industry.

## METHODOLOGY

**Selection of study area:** The area along the Hhelehhele - Lonhlupeko main road (MR 3) was used as a case study. It was selected because of the large number of stalls of firewood that were displayed for sale along the road. During a reconnaissance survey of the lowveld roads 37 stalls were found along this road of a distance of about 47 Km (average of 1.3 stalls per km as compared to the road from Hhelehhele to Big Bend with a distance of about 60 km and only 29 stalls (average of 1 stall per 2 Km). Figure 1 shows the location of study area with major towns.

**Data collection:** A systematic sampling was used where every second stall was selected for sampling in order to sample 18 stalls, which is about 50 % of the total 37 firewood stalls found along the road. A questionnaire was developed and used to collect information on the methods

used to obtain firewood, the tree species used as firewood, the source of firewood, and the contribution of firewood to the livelihood of the sellers. Information was also collected on tree species sold as firewood. The firewood from each stall was also weighted. The research provided exploratory information, as the sampled stalls were very few, and fell short of a statistical representation of firewood sellers in the country.

**Satellite image analysis:** Landsat TM data for December 1994 and Landsat ETM data for December 2006 were processed to determine forest and woody tree cover for the different periods within the study area. The satellite data used for both instances were in the Red, Near Infra Red and Middle Infra Red bands. Both Landsat TM and Landsat ETM data have a spatial resolution of 30 m, meaning that landscape features detected were those with area of 900 m<sup>2</sup> or above. The three bands were combined to produce a composite image that was used for unsupervised image classification for both instances (1994 and 2006). The number of clusters was fixed at 10 during the unsupervised image classification. Reflectance values were extracted for each band for the different years, and Normalized Difference Vegetative Index (NDVI) values were calculated for all the clusters as described by Lillesand and Keifer (1994). Reflectance values of Red bands were plotted against Near Infra Red bands to produce "scatterplots" (Walker *et al.*, 1986; Manyatsi and Ntshangase, 2008). The clusters were classified into presence of forest/woodlands and absence of forest/woodlands on the basis of the location of the clusters on the "scatterplots" and NDVI values (Walker *et al.*, 1986; Manyatsi, 1997; Manyatsi and Ntshangase, 2008). Clusters that fell along the "greenness" line with high NDVI values were classified as forest/woodlands, while those that did not fall along the "greenness" line were classified as absence of forest/woodlands. IDRISI Andes edition software was used for satellite image processing (Clark Labs, 2006). The processed images were converted from raster format to vector format and exported to "shapefile" for further processing in ArcView GIS (ESRI, 1999). The road from Hhelehhele to Lonhlupeko was digitized on the screen from a digital topographic map. A buffer zone of 3 km was created on both sides of the road, and the "shapefiles" were clipped to fit the buffer zone. The assumption made was that firewood was collected within 3 km along the road. The area covered by forest/woodlands was estimated for each year from the clipped "shapefiles".

## RESULTS AND DISCUSSION

**Forest and woodland cover:** The total area under forest/woodlands increased from 10,372 ha in 1994 to

14510 ha in 2006. This showed an increase of 39% in forest/woodlands cover over the 14-year period (Fig. 2). The forest/woodlands classification that was based on remotely sensed data (Landsat TM for 1994 and Landsat ETM for 2006) included dense shrubs. The results concurred with those of Roques *et al.* (2001) which reported that shrub cover increased from a mean of 2% in 1947 to 31% in 1990 in some parts of Swaziland. The increase in forest/woodlands cover was associated with bush encroachment, which is major threat to agricultural productivity in the lowveld of Swaziland (Tefera *et al.*, 2008). Bush encroachment results from overgrazing, displacement of climax community or lower carrying capacity (Jacob, 2000). The clearing of land for cultivation and the extraction of firewood and building material removed the majority of trees and shrubs from communal land in Swaziland (Manyatsi, 1999). The lowveld of Swaziland, including the study area has experienced drought and low rainfall since the early 90s, and arable land has been lying fallow. The observed encroaching plant species included *Dichrostachys cinerea*, *Acacia burkei*, *Acacia tortilis* and *Chromolaena odorata*, which is an alien invasive plant.

**Sustainability of harvesting firewood:** A total of 13750 Kg of firewood was displayed for sale at the 18 stalls. The dominant tree species that were harvested for firewood were *Acacia nilotica*, *Dichrostachys cinerea*, *Acacia Caffra*, *Euclea divinorum* and *Melia azadararach*. *Faurea galpinii* constituted 0.73% of the firewood found on the stalls (Fig. 3). All the tree species used as firewood were not scheduled except *Faurea galpinii* that falls under Schedule B (Vulnerable Flora) and is protected by the Flora Protection Act of 2001. Sixty seven percent of the respondents obtained their firewood from adjacent government farms, 23% obtained their firewood from Swazi Nation Land and another 11% obtained it from private farms (Fig. 4). The Forest Preservation Act of 1907 and the Private Forests Act of 1951 are applicable to all the respondents as they either harvested or collected the firewood for sale. Seventy eight percent of the respondents had permits to collect firewood from the government farms and private farms. The permits were issued by the management of the farms, and not by the Minister of Agriculture or his representative. They allowed members of the community to collect firewood, cut poles and thatch grass for domestic use only, and not to sell the products. One permit that was issued by Dalcrue Agricultural Holding to community members specified the protected tree species that should not be cut or harvested. The fact that the permit gave a list of tree species that should not be harvested may have played a major role in protecting the scheduled tree species, as they did not form a large proportion of firewood that was

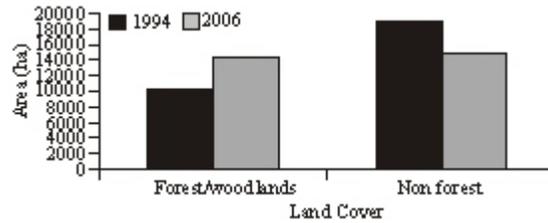


Fig. 2: Area under forest and non forest cover for 1994 and 2006

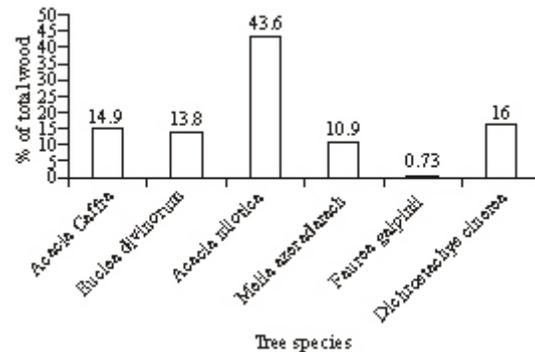


Fig. 3: Tree species harvested for firewood

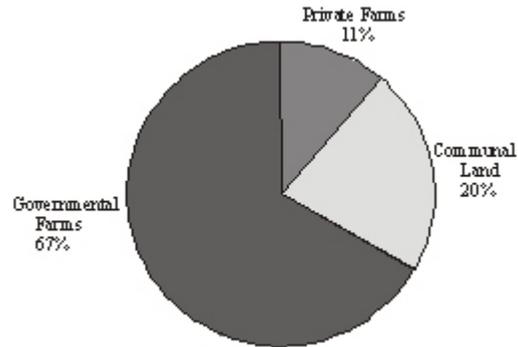


Fig. 4: Source of firewood for respondents

displayed for sale. Only one respondent had a permit to sell firewood along the road. The other respondents claimed to be not aware that permits were needed to trade on firewood.

**Methods used for transporting firewood and amount harvested:** The majority of respondents (56%) picked dead wood and did not cut any trees for firewood, with 22% cutting trees for use as firewood. Another 22% picked dead wood and also cut trees for firewood (Fig. 5). The majority of the respondents had to travel for over two km in order to harvest firewood with another 28% traveling for between one km and two km. Only 11% obtained firewood from distances of less than one km (Fig. 6). The observed increase in the area covered by forest/woodlands did not result in abundance of firewood harvest, as the encroaching species were mainly bush and

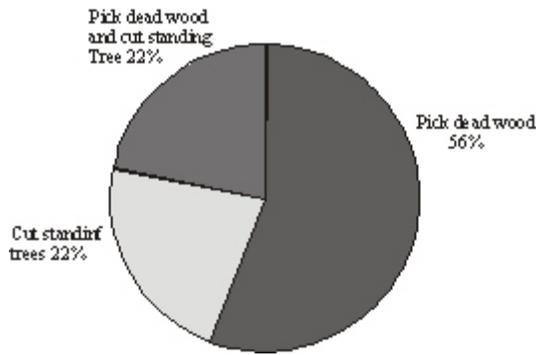


Fig. 5: Methods of harvesting/collecting firewood

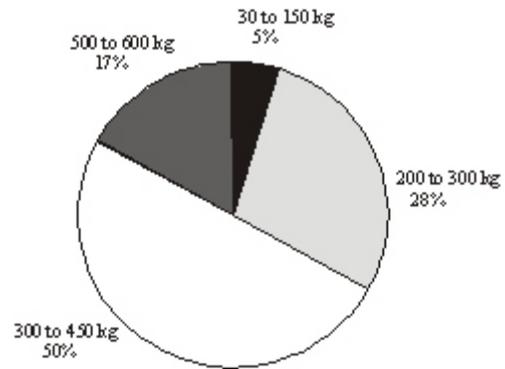


Fig. 8: Average daily firewood harvested by respondents



Fig. 6: Distance traveled by respondents to harvest firewood

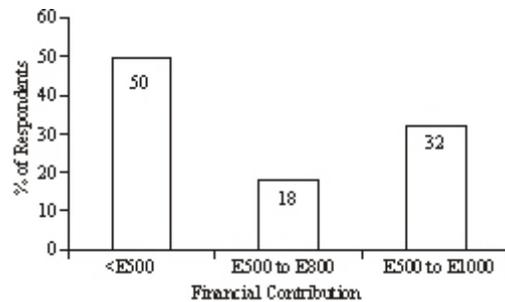


Fig. 9: Financial contribution of sale of firewood to respondents (1 US\$ is approximately E8.3)

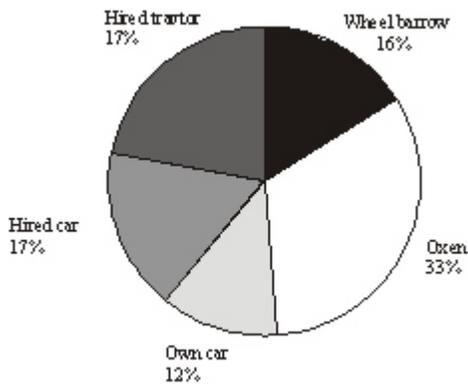


Fig. 7: Methods used to transport firewood from harvest sites.

shrubs. About 33% of the respondents used animal draught power (oxen) to transport firewood from harvest sites to sites where they were sold. Another 22% hired tractors, with 17% hiring cars to transport the firewood. Sixteen percent used wheelbarrows and another 12% used their own cars to transport firewood from harvest sites (Fig. 7). The amount of firewood harvested at a time was not regulated, and it depended on the demand. Those using cars and tractors tended to harvest large amounts at a time though. One respondent harvested an average of between 30 and 150 Kg of firewood in a day with 28%

harvesting an average of between 200 and 300 Kg of firewood in a day. Fifty percent harvested between 300 and 450 Kg, and another 17% harvested between 500 and 600 Kg on a daily basis (Fig. 8).

**Contribution of sale of firewood to livelihood:** The households within the study area were very vulnerable to poverty as the area has been receiving reduced rainfall over the past 15 years due to prolonged drought, and there were very few alternative sources of income generating activities or formal employment. In a study on coping strategies for the poor households in the Great Ruaha catchment in Tanzania, Kadigi *et al.* (2007) reported that specific bottlenecks included limited access to natural resources, physical production capital and social capital. The respondents cited lack of employment opportunities as the main reason for engaging in the business of sale of firewood. The financial contribution of sale of firewood to the respondents ranged from less than E500 (US\$ 67) per month to about E1000 (US\$ 133) with about 50% earning less than E500. About 18% earned between E500 and E800 (US\$ 67-US\$ 107). Thirty two percent earned between E800 and E1000 per month (US\$ 107-US\$ 133) (Fig. 9). The contribution was comparable with that of informal water development in Mdonjane area that is situated in the upper middlelevel of Swaziland (Manyatsi and Mwendera, 2007). Unlike in the lowveld, Mdonjane

is endowed with water, and some households were earning as much as US\$ 200 per month from sale of irrigated crops. The buyers of firewood were mainly motorists traveling towards the city (Manzini), with other community members buying firewood in small quantities for cooking purposes whenever needs arise.

**Impact on environment of firewood industry:** Firewood is a valuable source of renewable energy in Swaziland. Burning wood to warm homes has been part of Swazi culture for centuries. Dead trees and fallen timber are vital habitat for a diverse range of fauna. Not only does standing and fallen dead wood provide habitat for fauna, but it also plays an essential role in maintaining forest and woodland nutrient cycles. The firewood collection can have a detrimental impact on Swaziland's wildlife and the tree species that are popular sources of firewood may decline if the industry is not controlled.

### CONCLUSION

The area under forest/woodlands has increased by 39% over the past 14 years due to bush and shrub encroachment. The increase in shrub and bush did not result in increase in availability of firewood as the respondents had to travel for long distances in search of firewood, as it was not available within short distances from the road. The contribution of sale of firewood to the livelihood of the respondents was significant, as about half of the respondents earned more than E500 (US\$ 67) per month from the sale. Such sellers were financially better than the 69% of the Swaziland population that live on less than US\$ 60 per month. It was evident that there was lack of enforcement of laws, as firewood was displayed along the roads yet the sellers did not have permits to sell it. The Ministry of Agriculture that is responsible for enforcing the Forest Prevention Act of 1907 and the Private Forest Act of 1951 was not taking any actions against the illegal sale of firewood. The harvest of firewood was not regulated, as there were instances where live trees were cut for firewood, and sellers could harvest as much as they wanted without any limit. There were instances where protected tree species were harvested or collected for firewood.

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